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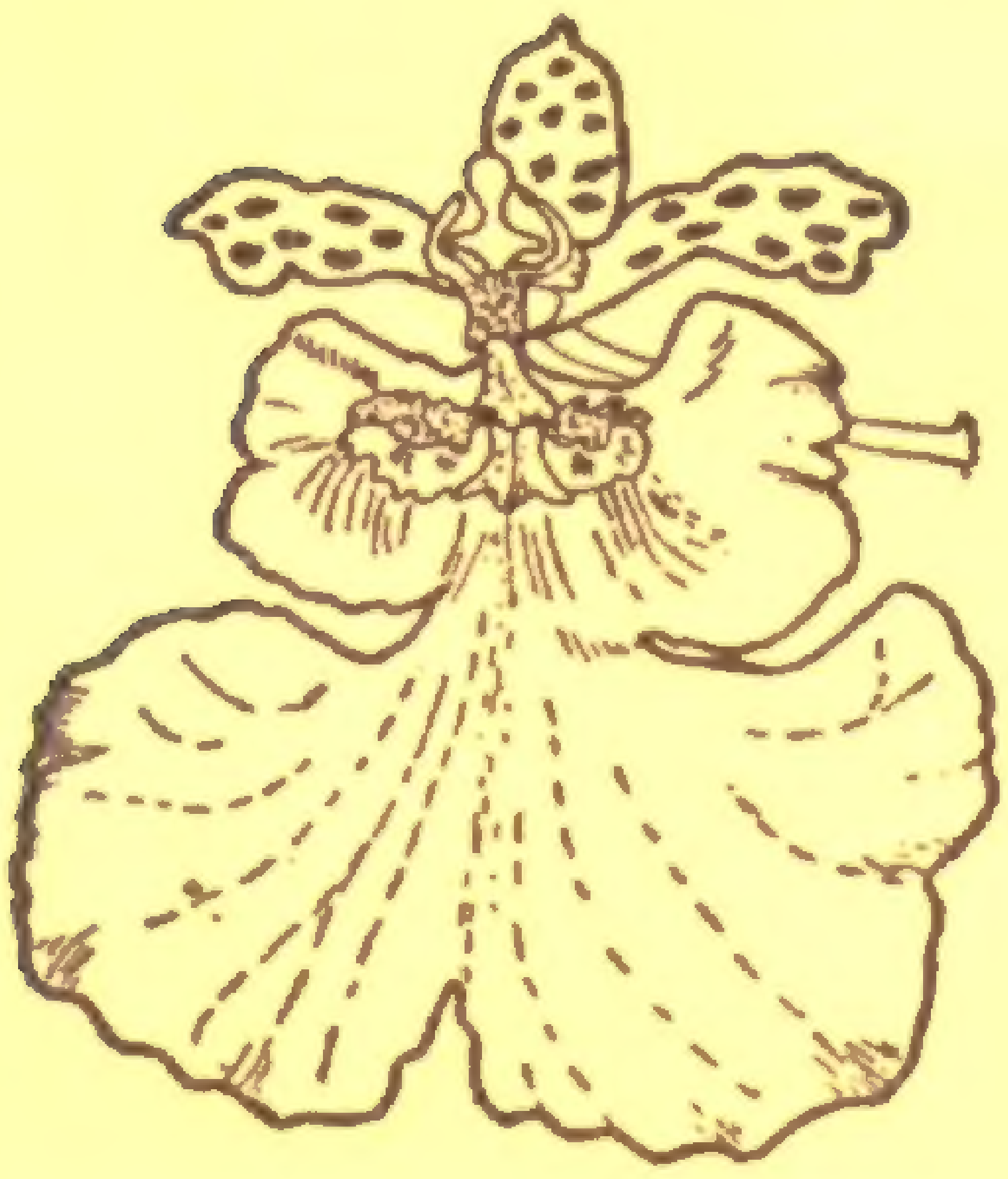
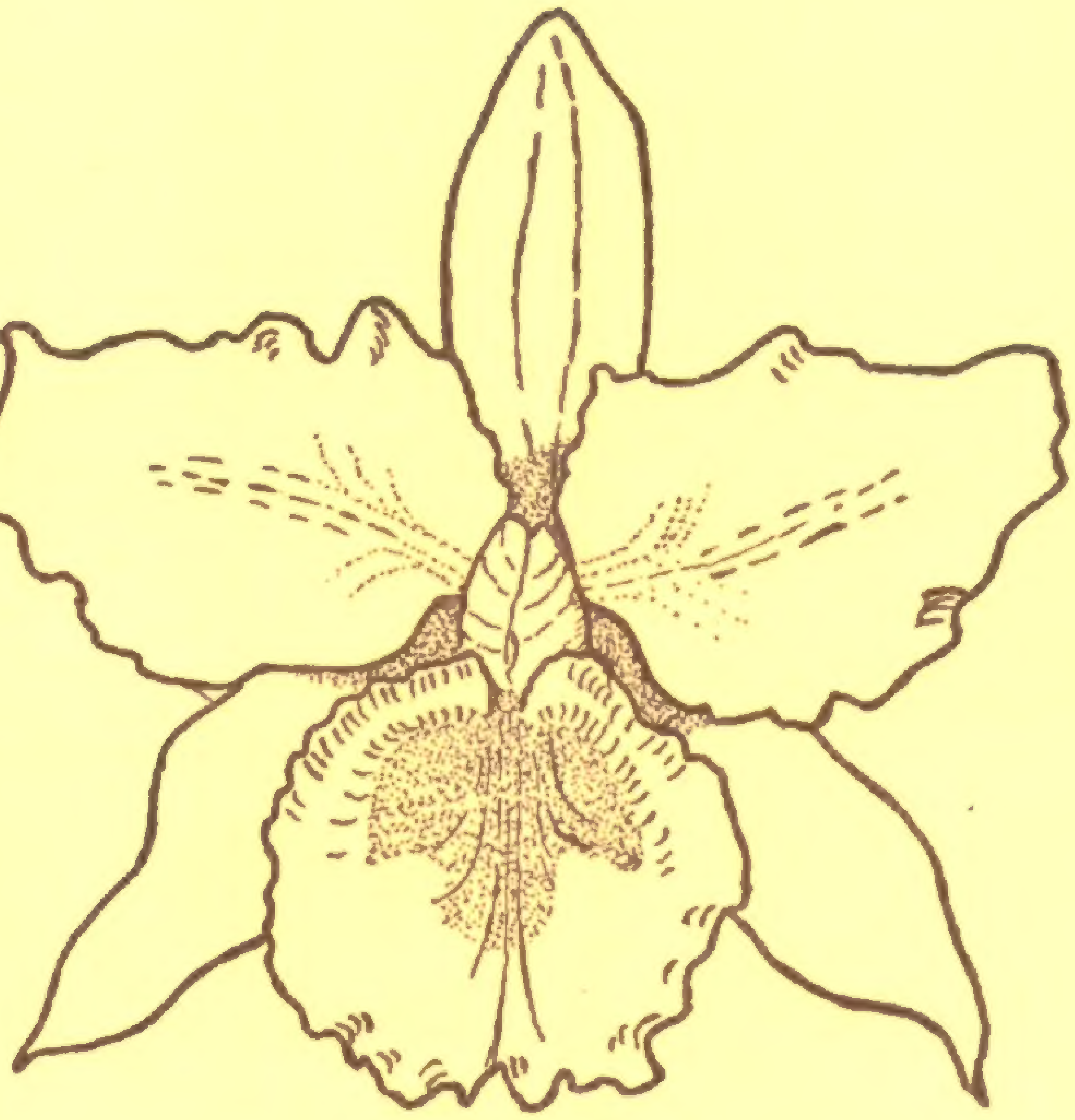
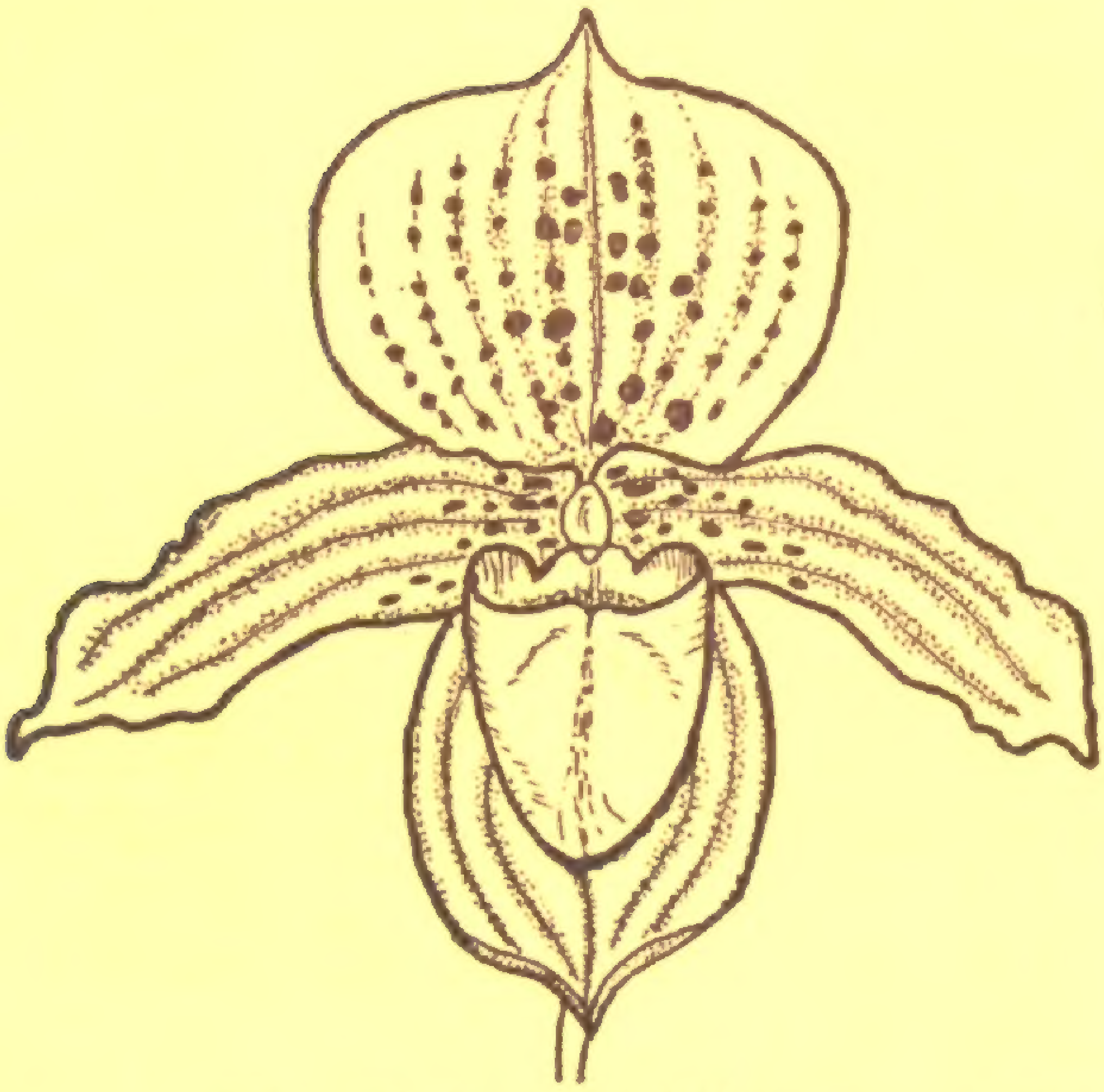
Orchid Culture



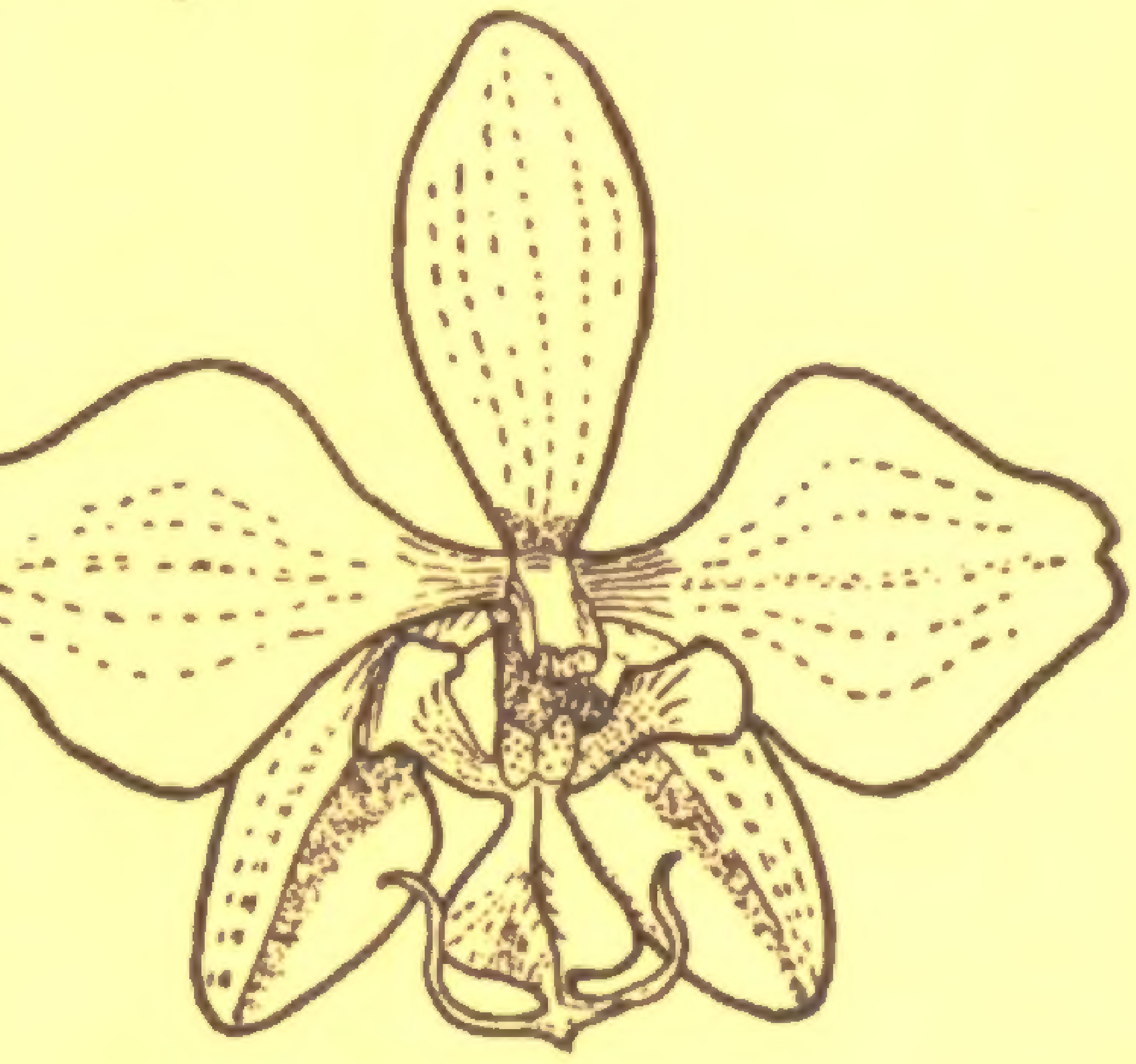
Oncidium



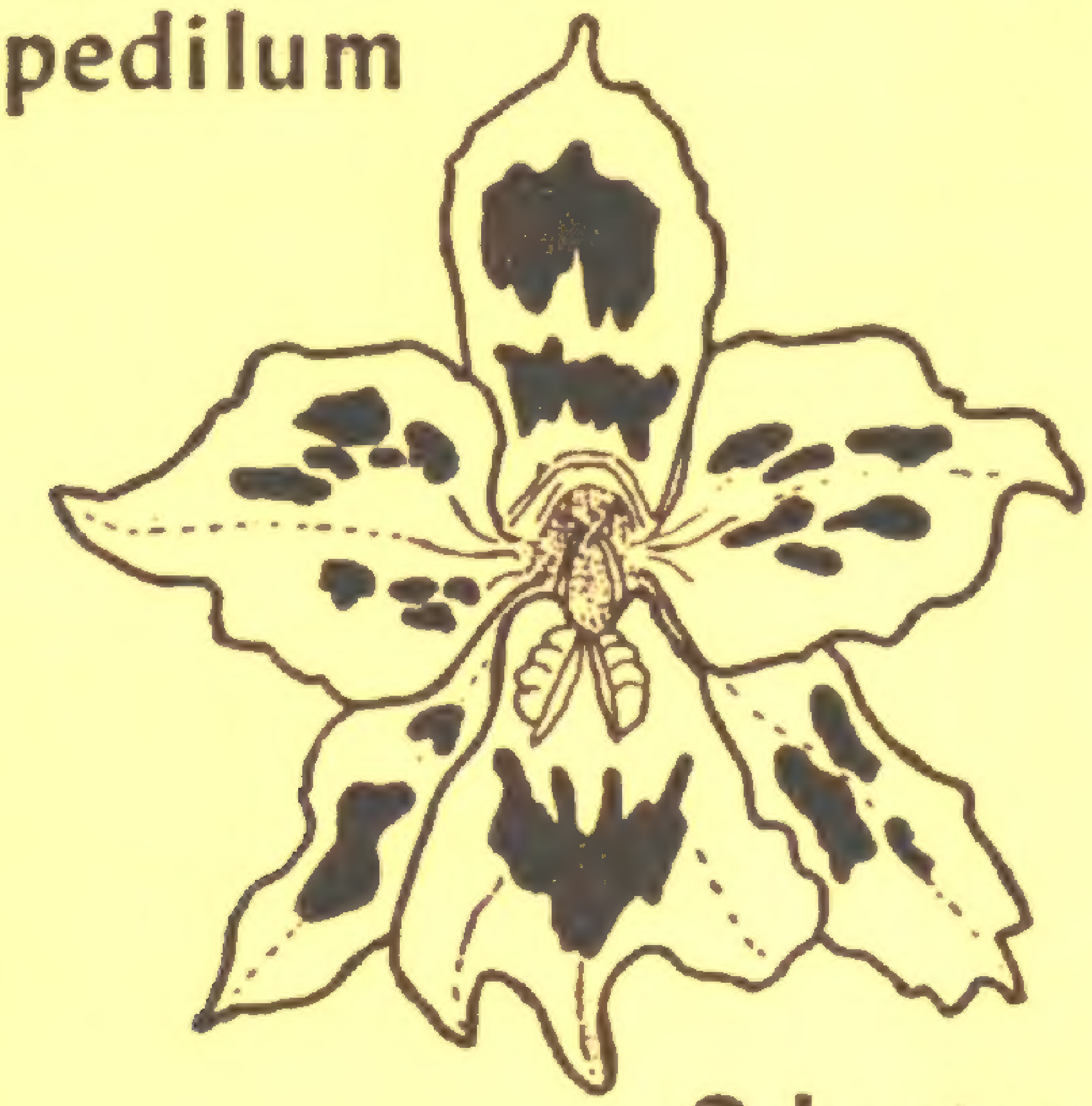
Cattleya



Paphiopedilum



Phalaenopsis



Odontoglossum

MISSOURI BOTANICAL GARDEN

COVER: Orchid drawings by Kenneth Peck.

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ORCHID CULTURE

ROBERT J. GILLESPIE

INTRODUCTION

THE Orchid family is the largest family of flowering plants. It has been estimated that of the world's flowering plants adapted to culture, in terms of total numbers, one in seven is an orchid. The orchid family (the Orchidaceae, *Orchid-ay'-see-e*), consisting of 15,000 to 20,000 species, is an extremely successful and prominent plant group found in every climate and type of habitat except the very driest deserts and the polar regions. Orchids are particularly abundant in the tropics, with two main geographical centers of distribution in Central and South America and in Southeast Asia.

Perhaps the most fascinating feature of the Orchid family is the tremendous variation which its members display in both their vegetative and floral structures. Even with such extreme variations, botanists recognize the orchid family as an excellent "natural" plant group. All of these plants have in common certain basic characteristics which indicate that they are orchids. These characteristics can be summarized briefly as follows:

Perennial herbs with tuberous or fibrous roots; stems without annual rings; minute embryo with one cotyledon; leaves with parallel veination; flowers with three sepals and three alternating petals one of which is modified into a lip; floral sexual organs united into a single structure called a column; pollen often united into waxy spherical masses called pollinia; ovary one-chambered with 3 carpels, inferior, with abundant minute ovules.

While orchids have been cultivated in the Orient for centuries, it was not until 1731 that Europe's first tropical orchid, *Bletia purpurea,* arrived in England from the Caribbean region. The first Asian orchids came to England from China in 1778. They were *Phaius Tankervillii* and *Cymbidium ensifolium.* By 1800, Kew Gardens had the largest collection of epiphytic orchids in Europe consisting of about 20 species, with Oncidium, Epidendrum and Lycaste well represented genera.

Early attempts to cultivate epiphytic orchids in Europe were extremely primitive and most plants were able to survive for only a limited time. Horticulturists lacked even the basic concepts of Orchid culture and they attempted to grow these supposed "tropical parasites" in an environment which corresponded to their ideas of a tropical habitat. First of all, orchids were always kept in very hot greenhouses into which little or no fresh air was ever admitted. The atmosphere was constantly saturated and the plants were usually kept extremely wet. Because orchids were considered parasitic, they were potted in a variety of media such as decaying and moldy wood, rotting vegetation or just plain garden soil. Despite the brutal treatment received, some plants were able to survive for rather lengthy periods of time.

The 19th century saw a veritable "Orchid Craze" overrun England, much as the "Tulip Mania" had swept Holland in the 17th Century. Every large estate had its orchid collection and English aristocrats sought, and paid tremendous prices for, rare or unusual orchids. Collectors representing both private and commercial establishments invaded the tropics to collect and export millions of orchids, most of which succumbed after a few years, to be replaced by vigorous, freshly-imported stock.

In 1835, a significant year in the history of orchid culture, Joseph Paxton, gardener for the Duke of Devonshire, stated his directions for growing orchids, thus laying the foundations for modern orchid culture. Paxton actually investigated and recorded facts about the climates where various commonly-cultivated orchids were collected. He then attempted to duplicate these conditions in his greenhouses. His success was instantaneous and his plants flourished to the degree that most English orchid growers very quickly adopted his methods. The cultural recommendations of Joseph Paxton can be summarized as follows:

1. Orchids from different altitudes should be grown at different temperatures.
2. Fresh air should be admitted into the greenhouses and the atmosphere should be kept only moderately moist.
3. A well-aërated potting medium as well as a well-drained container should be used.

Gradually through the years, Paxton's cultural principles have grown until now, horticulturists know most of the basic cultural requirements for all of the major cultivated orchid groups. The orchid grower today has over a century of knowledge and hard-earned experience to draw upon.

THE MAJOR CULTIVATED ORCHID GROUPS

The cultivated orchids encompass such a tremendous number of species indigenous to a variety of habitats that to discuss them all here would obviously be impracticable. Therefore, this treatise will include only the six major cultivated groups: The Cattleya group, the Cypripedium group, the Cymbidium group, the Odontoglossum group, the Dendrobium group and the Vanda group.

The reader should bear in mind that while discussing the details of culture of these groups, it is not possible to set forth precise formulae which, if adhered to faithfully, will insure success.

The maintenance from day to day of optimum conditions around any orchid is to a large degree a problem which must be worked out by each individual grower in his own growing area. The broad general cultural details can be presented, but each grower, to have a well-grown collection, must find the proper combination of the many minute environmental factors. Also, it must be realized that it is impossible for man to duplicate precisely the native environment of any orchid plant. For example, we cannot hope to give an orchid the same day-length pattern which exists in the tropics. Our temperatures may be too hot in the summer and too cold in the winter. Because the plant is growing in a pot, the watering schedule must be different from nature's watering pattern. Thus it becomes necessary for man to work out a set of environmental conditions which, though different from those of the plant's natural habitat, will, never-the-less, provide the requirements for best growth and development. Man can frequently control the environment of a plant to a degree that permits near-maximum growth under more ideal conditions than in nature where the plant is subjected to rapid and whimsical environmental changes. Consequently, many orchid growers have found, much to their surprise, that some orchid plants grow and flower more luxuriantly under cultivation than they do in their native habitats.

THE CATTLEYAS AND THEIR ALLIES

Cattleyas are the most popular of all the orchids and they are the principal flowers of the orchid cut-flower industry. Over 60 per cent of the orchid plants in cultivation are Cattleya species or hybrids. The genus is native to Central and South America where populations are found growing at altitudes of 3000 to 6000 feet. Here the temperatures range from 60° F. at night to about 75° during the day. The relative humidity varies from 50 per cent to the saturation point. Precipitation occurs almost daily, temporarily drenching the plants; but the water drains off quickly leaving the plants' root systems relatively dry. The light is usually rather intense and the plants are shaded by only a few leaves and branches. The cultivation of Cattleyas requires slight modifications of this natural environment.

TEMPERATURE

Orchids are classified into three groups according to their temperature requirements:

1. The warm orchids, such as the genus Phalaenopsis, which are found in low, hot, regions of the tropics and which require day temperatures of 75° and above, and night temperatures ranging from 65° to 70°.
2. The intermediate orchids, to which the Cattleyas belong, which grow best at day temperatures of 70° and above, and night temperatures of 60° to 65°.

3. The cool orchids—plants, such as the Odontoglossums, that are native to the high mountain areas where cool days and chilly nights are the rule—which prefer day temperatures from 60° to 70° and night temperatures of 45° to 50°.

Plants from the first two groups are best subjects for home culture and for growing in areas where the summer temperatures are extremely hot.

Cooling techniques: In the greenhouse, Cattleyas are usually grown at temperatures of about 60° at night and from 70° to 85° during the day. In the summer these temperatures cannot, of course, be maintained, especially in the greenhouse where during the day the temperature may soar to 100° or over. During such hot spells, periodic dampening down of walks and the gravel beds or benches between the pots, as well as lightly spraying the plants themselves will help to minimize the harmful effects of high temperatures. Such recent innovations as evaporative coolers and fog-mist devices help tremendously in keeping down summer temperatures in the greenhouse. They can frequently keep a greenhouse 15 to 20 degrees cooler than the outside temperature.

Importance of Lower Night Temperatures: While day temperatures can vary considerably with little harmful effect, the maintenance of optimum night temperatures is extremely important. This is true, not only for Cattleyas, but also for most cultivated orchids. For example, some orchids will grow well and initiate flower buds at a night temperature of 55°. These same plants will grow poorly and will not initiate flowers if kept at 60° at night.

Preventing Sudden Temperature Changes: It is not only important to maintain the proper day and night temperature in the home or greenhouse; but it is also important to avoid rapid temperature fluctuations. On a cold winter morning, for example, the sun can suddenly raise the temperature in a greenhouse from the cool night temperature to a warm day temperature in a few minutes. The smaller the greenhouse, the more quickly it is heated by the sun, for its glass surface area is very large in relation to its volume. Rapid temperature rises around an orchid plant mean that the plant's leaves become warm and physiologically active while the root system, in its solid rooting medium, is still very cold and consequently physiologically dormant. The active leaves are demanding large quantities of water and nutrients which the root system cannot possibly supply. Under these conditions, photosynthesis, transpiration and other vital plant processes are severely restricted, as a result developing flower buds and new growths can be damaged. Rapid rises in temperature on sunny days can be avoided by gradually opening ventilators early in the morning, thus permitting the greenhouse to warm up slowly. Watering the plants with warm water will help to raise the root temperature.

LIGHT

How much light intensity does a mature Cattleya require? That, unfortunately, is a relative question. A mature Cattleya in good condition and free of disease should grow well if it receives about 3000 foot-candles (F.C.) of light. Some growers prefer to use up to 5000 F.C.; however, a Cattleya must be in very good condition to withstand such high intensities since leaf burning or the bleaching of chloroplasts can easily occur. It is doubtful, therefore, if any real benefits can be derived from extremely high light intensities.

The best criterion for judging optimum light intensities for a plant is the condition of the plant itself. A Cattleya with lush dark green leaves and soft succulent growths is not receiving enough light. Extreme yellowing and bleaching or burning of the leaves indicates too intense light. A well-grown plant receiving optimum light should have leaves with a slightly yellow cast and a hard leathery texture. A heavy concentration of red or purple pigments (anthocyanin) in the pseudobulbs or leaves, as well as slight anthocyanin speckling on the flower sheaths of some Cattleyas indicates good light conditions.

Controlling Light: Greenhouses require some form of shading from March through October with the heaviest protection needed during July and August when 30 per cent of outdoor light intensity is admitted. Clear glass is preferable from November through February. White shading compound, sprayed or painted on the glass, is a very satisfactory form of shading although some orchid growers prefer lath shades or plastic shading cloth.

HUMIDITY

Water in the gaseous state, is an important factor in any orchid's environment. Most orchids prefer a relative humidity between 50 and 80 per cent of saturation. An extremely humid atmosphere that is not moving is particularly undesirable. It is important for every orchid grower to remember that relative humidity usually varies inversely with the temperature. This means that on an average summer day in the Midwest, the morning temperature may be 70° and the relative humidity can be 100 per cent or at the saturation point. By early in the afternoon the temperature may be 90° but the relative humidity may have fallen to 40 per cent of saturation. As the temperature falls in the evening the relative humidity once again increases. Therefore, on sunny days it is usually necessary to increase the humidity in the greenhouse by dampening down floors and benches and lightly spraying the plants. This should be done before noon so as to prevent excessive plant transpiration which would occur if the humidity were drastically decreased, and also to allow the greenhouse to dry before evening thus preventing excessive condensation. Artificial heat in a greenhouse has a drying effect and the orchid grower must always be on guard against an arid atmosphere during the heating season.

WATERING

How wet is wet and how dry is dry? This is the question which continually haunts the novice orchid grower. Unfortunately, there is no unit of measure like the degree or the foot candle which can be used as a precise indicator in watering. No set rule on watering frequency can be given. However, as a general rule of thumb, a Cattleya should be "pot-watered" when the medium in which it is growing is approaching the state of being completely dry. The plant should never become completely dry; on the other hand, it should not be watered if the root system is fairly moist. When "pot-watering," the potting medium should be thoroughly saturated; but the excess water should drain away quickly. Watering twice a week would be about average for most mature Cattleyas under normal greenhouse conditions. During the warm summer period, more frequent pot-waterings are required, while during the dull winter months a more restricted schedule should be followed. Extremely cold water should not be used and water containing high amounts of salts or which is excessively alkaline or acid should be avoided. Above all, it is important to remember that in nature the Cattleya is watered by a system which alternately soaks and dries the plant.

VENTILATION

Outside air is essential for all green plants, since it supplies them with much-needed carbon dioxide. Also, a constantly moving, light buoyant atmosphere keeps orchids vigorous and healthy. Damp stagnant greenhouse conditions encourage molds and bacterial and insect diseases. Orchid pots should be staged on open decking or on wire screening so as to allow air movement below and around the pots. Many growers are now using greenhouse fans which are kept running day and night, constantly moving the air throughout the greenhouse and thus preventing a musty atmosphere. Evaporative coolers are excellent aëration devices during the summer months for they not only lower greenhouse temperatures but they also move large quantities of fresh air through the greenhouse without creating drafts.

Greenhouse ventilators should be opened whenever possible. This may mean only "cracking" the vents for an hour on a cold, dull winter day or it may mean leaving them open for rather long periods of time during the warm summer months. Drafts should be avoided at all times and ventilators should always be opened away from the direction of the wind. This is particularly important during the winter months.

POTTING

Successful orchid growers constantly analyze their growing procedures in order to find weak links where optimum conditions are not being maintained. Potting practices are frequently the weakest link in the orchid grower's chain. In only a few minutes an improper job of potting can undo months, even years of good culture. It is imperative, therefore, that every grower understand exactly how and when orchids should be repotted. Unfortunately, potting is as much an art as it is a science and while the technique can be studied through the literature and in illustrations, it still cannot be mastered without actual practice. If possible, every novice orchid grower should receive at least one potting lesson from an experienced potter. He would benefit more from such a lesson than he could from studying numerous articles or illustrations.

When to Pot

Regardless of the size of growth or of the flowering pattern exhibited by any plant, the best time to repot a Cattleya is just at the time when its new vegetative growths are sending out a flush of roots. The new growth on one particular plant may be only an inch or two long when it "roots out," another plant may be in full flower and initiating roots at the same time. Potting almost always injures the existing root system of a plant. If the plant is not at a point in its growth cycle where it can quickly replace its lost roots with new vigorous ones, severe dessication and even death can result. If a plant is passed by and not repotted at the proper time, it is usually best to refrain from potting until the plant develops another growth and sends forth new roots. A Cattleya is in need of repotting when its new growths are extending beyond the pot or when the potting medium has broken down to the point where optimum growth is no longer possible. On the average, a Cattleya will need repotting once every 18 months to two years.

How to Pot

Potting procedures can be divided into three broad categories: a. preparation of potting materials, b. potting technique, and c. post-potting care.

Preparation of Potting Materials: Two basic types of potting media are now available to the orchid grower. Each of these materials is quite satisfactory; in most cases both produce about equal results. Osmunda fiber (the roots of the Osmunda fern, *Osmunda regalis*) has been in use for over 50 years. It contains all of the nutrients needed by epiphytic orchids; but it is expensive to buy and difficult to work with, requiring considerable practice for mastery of its use. Fir bark has been in general use for about five years and has almost completely replaced Osmunda fiber as a potting medium for epiphytic orchids. It is the bark from any of several species of western conifers, principally *Abies concolor*, the White Fir. While fir bark is nutritionally quite poor, it is, never-the-less, easy to use, relatively inexpensive, and seems to stimulate root development in some orchid species.

The following discussion of potting will be based on the use of fir bark. Those who are interested in using Osmunda fiber for potting will find in the appendix a list of references, some of which have well-written sections on its use.

For potting Cattleyas, the following materials are required:

Pots, pieces of broken pot (crock), fir bark, scissors, pruning shears, key-hole saw, wire stakes, string and celluloid orchid labels.

Fir bark should always be potted moist. Extremely dry bark loses its hygroscopic water and resists moistening so that a plant potted in dry bark can become dessicated even though it

E. L. EVINGER

An orchid grower's potting bench with fir bark and other potting materials.

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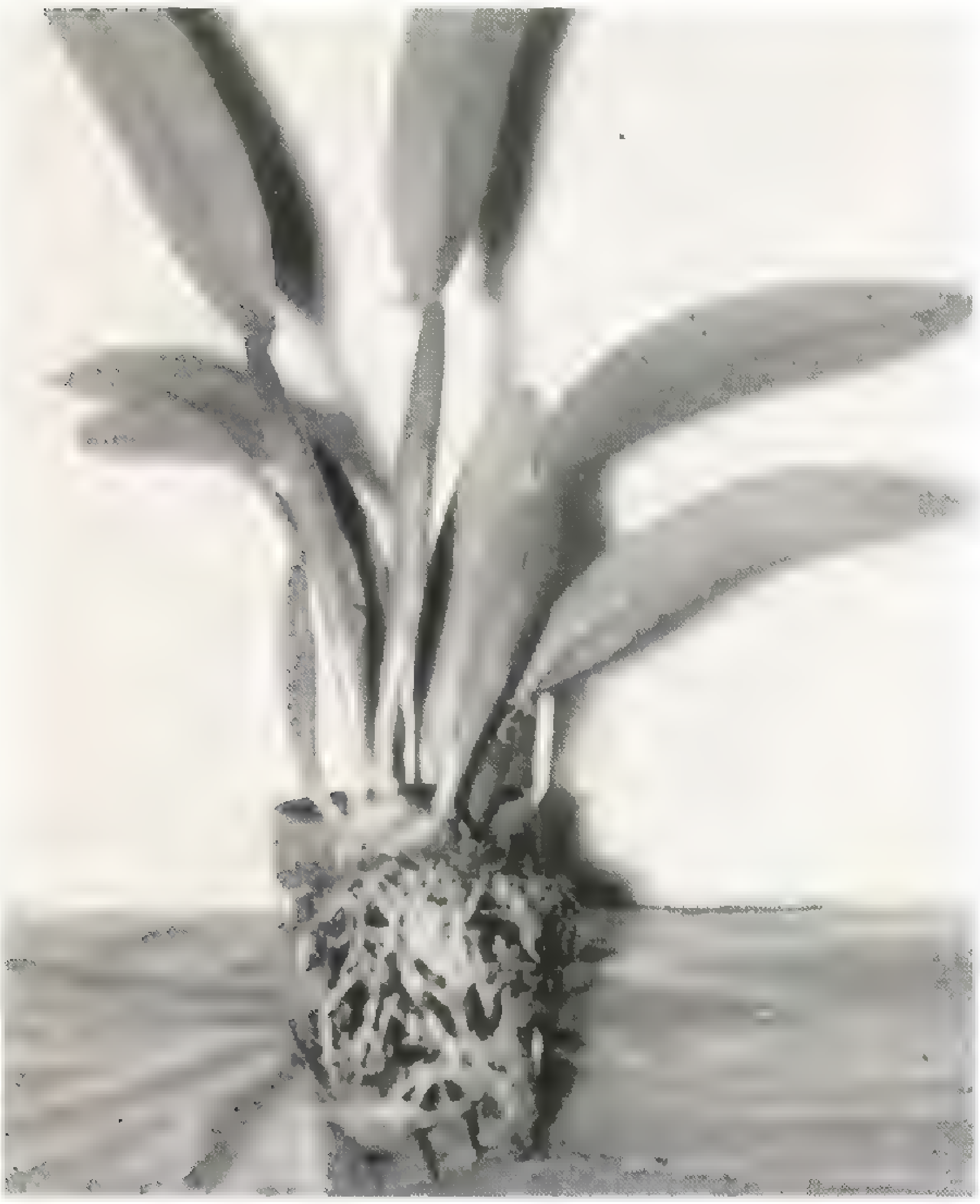
A hybrid Cattleya plant in need of repotting. Note new roots.



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Cattleya plant removed from pot showing the root system in fir bark.

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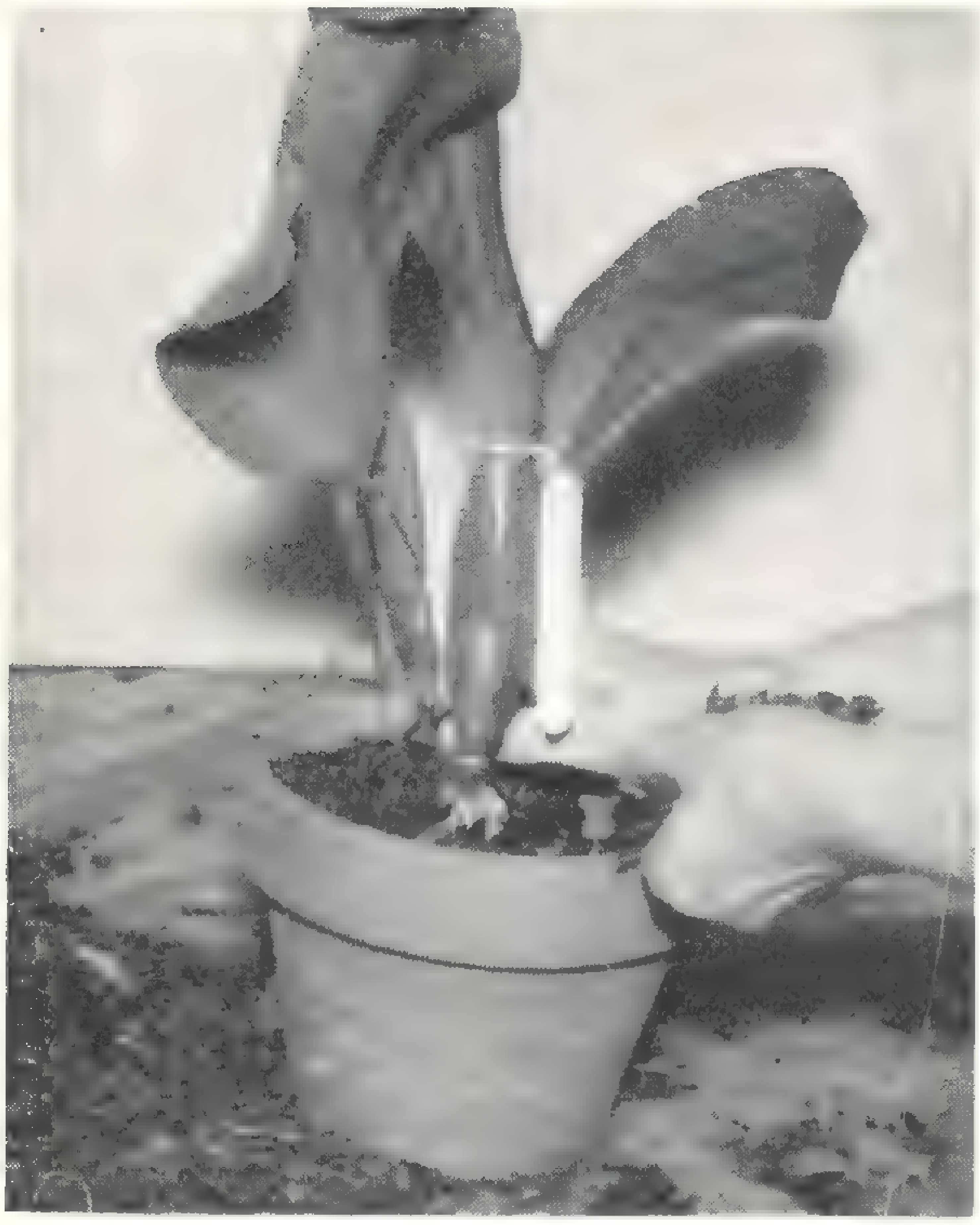
Root ball being divided with key-hole saw after rhizome was cut with pruning shears.



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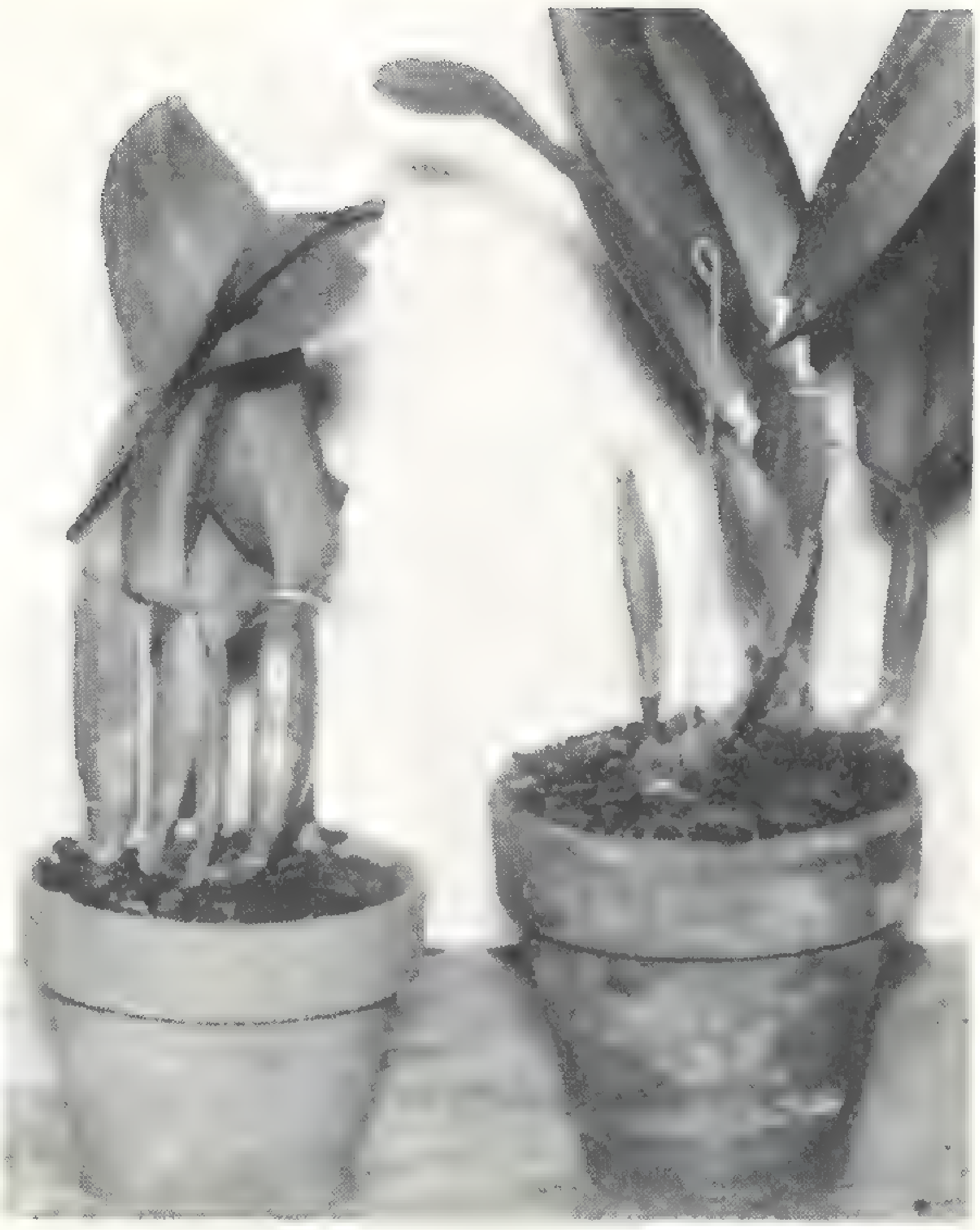
Newly separated division being potted in fir bark. Note that plant is being held with the youngest part in the center of the pot.



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On the left the newly potted division and on the right the remainder of the plant which was returned relatively undisturbed to the pot.

is watered properly. Freshly potted fir bark can be easily washed out of pots and it is necessary to use a water breaker or bubbler on the hose or watering pot to break the force of the water. It is important to use only the screened coarse grade of fir bark for potting mature Cattleyas. Finer particles tend to pack and drain poorly, thus preventing good root development.

Nutrients can be added to fir bark at the time of potting. If one standard 3-in. flower pot full of each of the following nutrients—super-phosphate, bone meal, hoof and horn meal, and a 10-10-10 water soluble chemical fertilizer—is mixed into a standard 3-cu. ft. bag of fir bark, it will supply the plants being potted in the material with enough food for a year and no supplemental feedings will be required.

Pots to be used should be clean and have no cracks. Three-quarter (azalea) pots are the type usually preferred but standard clay pots are adequate. The holes in the bottoms of the pots can be enlarged with a hammer to aid in drainage and to improve aëration.

Potting Technique: When repotting an orchid, the grower has an ideal opportunity to clean the plant, removing the dry sheaths covering the pseudobulbs and removing any scale insects (see Orchid diseases, Insect pests) by scrubbing infested areas with an aqueous solution of DDT. An old tooth brush works fine for this scale removing process. After cleaning the plant, the strings attaching it to the supporting wire stake should be cut and the stake removed.

The plant can be easily removed from the pot by inserting a pair of scissors half way down between the pot and the root ball. Then by prying up with the scissors the plant can be popped out of the pot with the root system intact.

If the plant is too large to be inserted into an easily handled pot, it should be divided. Each separated division should have at least three mature pseudobulbs with leaves for every lead (growing tip). This will insure that every division will have the leaf surface area needed to produce enough food for normal growth and development. The rhizome should be cut using a pair of sharp pruning shears at the selected point between two pseudobulbs. The rest of the root ball can then be cut through with a keyhole saw.

The next step in potting is to select the proper pot for each separated division. It is essential to use a pot which is not so large that the roots and medium are constantly wet nor so small that the contents are always dry. Most growers select a pot that will allow the inserted plant enough room to make two or three successive growths. The plant should always be potted so as to allow maximum room for future growth. This means that the oldest part of the plant should be butted against the pot in such a way as to allow the lead bulb to sit in the middle of the pot.

The pot selected should be filled to one-fourth full with crock. Then the division should be held in one hand, with the rhizome horizontal and about one-half inch below the rim of the pot; while, with the other hand, the fir bark should be filled in below and around the plant until it reaches the level of the rhizome. After this, the bark can be pressed down slightly with the thumbs, and a little more added to bring it to the top of the rhizome.

Insert the wire stake, taking care not to injure any dormant "eyes" located at the base of the pseudobulbs. Each bulb can then be tied to the wire stake in such a way that one leaf does not shade or hide another. After attaching the label indicating the date of repotting to the plant, it is ready to be returned to the growing area.

Post-potting Care: A newly potted orchid must receive special treatment until it recovers from the shock of repotting. This means the plant should be placed under slightly reduced light and watered sparingly until the roots are near normal. It should never be over-watered, for without an established root system to absorb excess moisture, the pot can remain saturated for an indefinite period and the newly developing roots will be smothered and will die. Newly potted plants should never be placed in a cold damp environment with little or no moving air, for these conditions are detrimental to root development.

If the fir bark is used without added nutrients, it is necessary to feed the plants monthly with a standard water-soluble chemical fertilizer at the strength recommended for house plants.

GROWING CATTLEYAS IN THE HOME

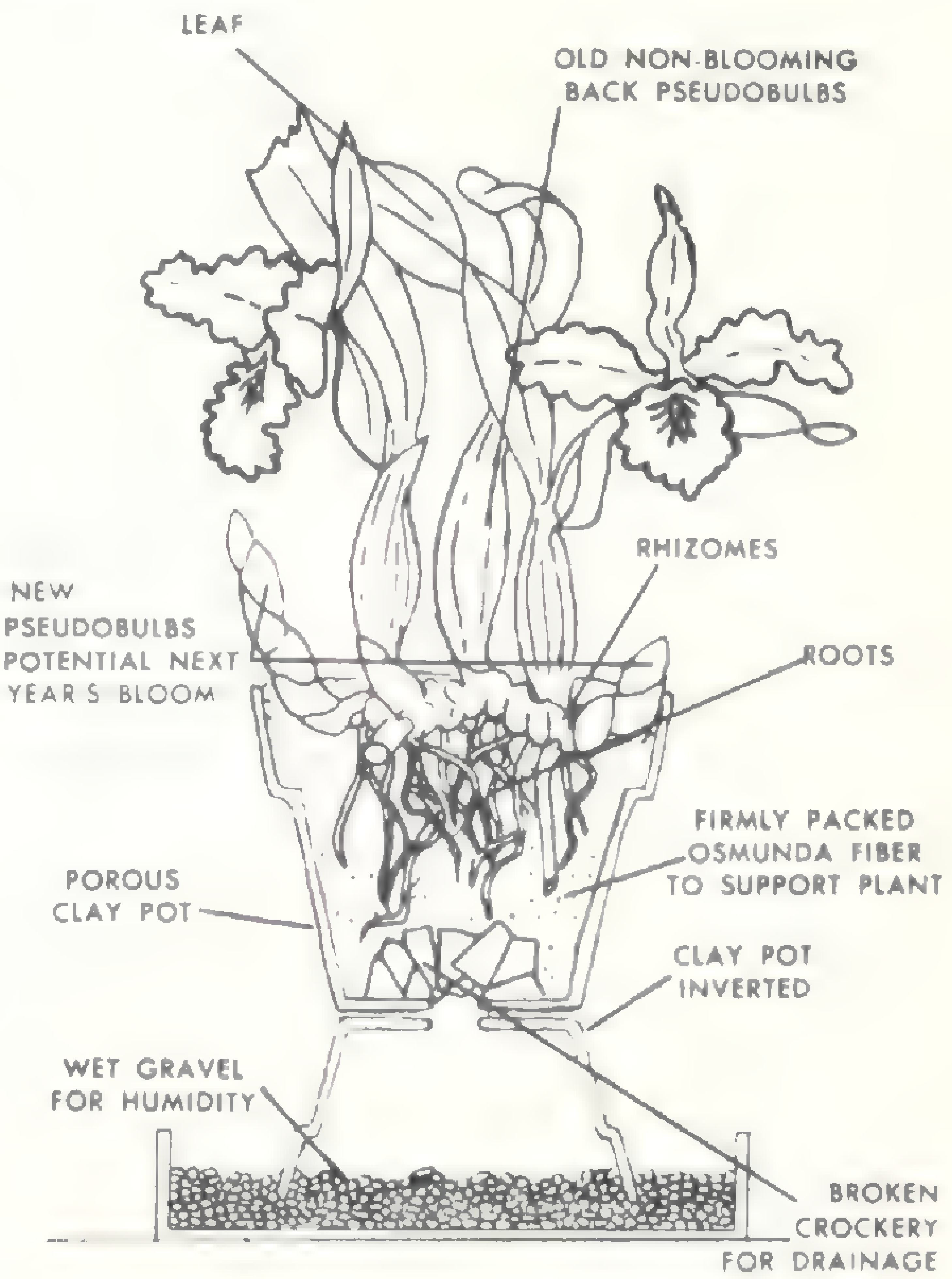
Cattleyas can be grown in the home. Every day home orchid enthusiasts are proving that this is true and that the experts who say it can't be done are wrong. It should be stated in the beginning that home orchid growers have brought out a fact which was not thoroughly understood prior to the home culture endeavor; and that is, that most orchid plants will grow and flower in an environment where one factor is not optimum. However, if two or more environmental factors are not optimum, the plant has difficulty surviving. This is important for the home culturist to know for he is growing his plants in a borderline habitat where the critical environmental factors must be carefully regulated. Analyzing the conditions in the average home, it becomes quickly apparent that the following factors are not optimum:

Humidity. The normal home has a relative humidity below the desired optimum for Cattleyas.

Light. Home conditions usually have too low light intensity.

Temperature. Most home night temperatures are above those required by Cattleyas.

Home orchid growers have overcome the above limitations in the following ways. Place plants in a bright sunny window with at least 6 hours of direct sun exposure a day. Some shading may be necessary in the spring and fall. The plants should be placed over (NOT IN, see diagram) a pan or tray containing gravel that is kept wet which helps to maintain a slightly higher humidity in the area of the plants. The plants can be sprayed daily; but this is not mandatory. During the winter months, the window area will be slightly cooler than the inner room area and consequently, the environment of the plants will be cooler, particularly at night. Therefore, care should be taken to prevent the plants from becoming chilled on severely cold nights. Most home growers have found that their plants benefit tremendously by being placed out of doors from May to September. They can be staged under trees or actually hung in the trees. Here the orchids should receive some direct morning and evening sun; but should be in filtered light during the rest


LEAF
OLD NON-BLOOMING BACK PSEUDOBULBS
RHIZOMES
NEW PSEUDOBULBS (POTENTIAL NEXT YEAR'S BLOOM
ROOTS
FIRMLY PACKED OSMUNDA FIBER TO SUPPORT PLANT
POROUS CLAY POT
CLAY POT INVERTED
WET GRAVEL FOR HUMIDITY
BROKEN CROCKERY FOR DRAINAGE

COURTESY JOHN F. NIES

of the day. Out of doors, orchid plants require considerably more water and, especially at this time, they should not be neglected.

Some Cattleya species and hybrids have proven themselves more suitable for home culture than others. *Cattleya mossiae* and its hybrids as well as the many beautiful Brasso-Cattleya hybrids are good home culture subjects.

THE CYPRIPEDIUMS

All of the Lady Slipper-type orchids belong to the Cypripedium group which contains only one extensively cultivated genus, the Paphiopedilums, epiphytic orchids native to Asia. The genus Cyprepedium may be familiar as a wild flower, since these Lady Slippers are terrestrial plants indigenous to North America. They are extremely hard to cultivate and are never grown in the greenhouse or home. Another genus in this group, Selenopedium, has never been successfully cultivated. The Paphiopedilums, then, are the Cypripediums of cultivation and horticulturists refer to them as such, or more frequently, by the affectionate abbreviation, "Cyps." This name will be used here in place of the proper botanical name.

Temperature: The Cyps are divided into two main groups according to their temperature requirements. The "warm" Cyps, distinguished by their mottled leaves, grow best at day temperatures from 75° to 80° and night temperatures of about 60°. The "cool" Cyps, with plain green leaves, require day temperatures from 70° to 75° and night temperatures from 50° to 55°. The warm varieties can be grown with Cattleyas, while the cool ones grow well with other cool orchids. However, both types can be grown together successfully, providing that the night temperature is carefully regulated at 55° to 58°.

Light: Cyps require considerably less light than Cattleyas; 2000 F.C. or about 20 percent of out-of-door summer light intensity is about optimum. As with Cattleyas, the color and texture of Cyp leaves are good indicators of whether or not the plant is receiving the proper intensity of light. A well-grown Cyp should have deep green, rigid leaves free from the surface wrinkles that would indicate tissue dessication.

Slight shading of greenhouse glass is necessary from mid-February to May and in the fall season. Heavier shading will be required during the summer months and none at all during the coldest months of winter.

Watering: With respect to watering needs, the Cyps differ from most of the other cultivated orchids in two ways: they lack pseudobulbs or any other water-storing organs and they have continuous growth. These characteristics dictate that the potting medium of Cyps should never become completely dry. No precise pot-watering schedule for these plants can be given; although, most growers give them a good soaking three times a week during the warm months and two times a week during the winter months. Overhead sprinkling of plant leaves and greenhouse walks on sunny days is always beneficial and should be done several times a day during the hot weather. Care should always be taken that water does not remain in the new growths for extended periods of time for new tissue can rot quickly.

Ventilation: A damp stagnant atmosphere will quickly arrest the development of Cyp flower buds and prevent their opening. Since these orchids thrive in a fresh invigorating atmosphere every effort should be made to maintain adequate ventilation throughout the year.

Potting: Soon after flowering, Cyps should be repotted and divided, if necessary, in the manner described for Cattleyas. The plant should be inserted about one-half inch below the surface of the potting medium. If it is set higher it will dessicate and if lower it will usually rot. Cyps also prefer small pots; too large a pot can induce waterlogging and root rot. Newly potted plants should not be pot-watered until a new root system has been established. Until that time overhead sprinkling of leaves several times a day will prevent dessication of the plants.

Garden and Home Culture: Many growers place their plants out of doors during the summer where they are grown in lath houses or under shade trees. Cyps will grow vigorously under these conditions, providing sufficient shade and water are supplied.

"Warm" Cyps make excellent home culture subjects and can be treated like almost any house plant. They should be placed over a gravel tray and kept moderately moist in an east window. In air conditioned homes both cool and warm Cyps seem to grow well. Many excellent specimen plants have been grown by home orchid enthusiasts.

THE CYMBIDIUMS

Cymbidiums are Asian orchids, indigenous to high elevations of the Himalayan and Khasia Mountains. The beautiful flowers of these orchids are carried on long arching sprays and their delicate colors, heavy waxy substance, and good keeping qualities have made them favorites with orchid growers everywhere.

More frequently than not, Cymbidiums are the stepchildren of the average orchid collection. Horticulturists know less about the environmental factors which influence their growth and flowering than they do about any other major group of orchids. Although the general requirements for Cymbidium culture have been established, the Cymbidium grower should be warned that many plants simply do not conform to any recognized flowering pattern and will persistently defy all efforts to induce flowering.

Temperature: Cool nights and mild days typify the mountain regions where Cymbidiums grow. Ideal day temperatures in the greenhouse should be 70° to 75° and night temperatures 50° to 55°. Summer temperatures in many areas will average considerably higher than this but the heat will not appreciably restrict growth and development providing all other environmental factors are maintained near optimum. Temperatures which fluctuate rapidly are undesirable, especially during the growing period for they can inhibit growth in some Cymbidium clones. Bud initiation normally occurs from August 15 to January 1. During this period cooler temperatures, preferably below 55° at night and under 75° during the day are necessary for flower bud initiation in many Cymbidium species and their hybrids.

Light: Cymbidiums require higher light intensities than Cattleyas, with 4000 F.C. of light being optimum for most varieties. Shading would therefore be lighter than for Cattleyas. High light intensities seem to be necessary, not only for good vegetative development, but also to promote flower bud initiation.

Watering: Cymbidium potting medium should never be allowed to approach the point of drying out. Plants potted in a well-drained compost can be flooded three times a week during the winter months; and, during the hot summer, daily pot-watering is not excessive. Restricted watering or severe drying of the potting medium during the growing season will usually stunt the developing growths and retard flowering.

Ventilation: Abundant fresh air is essential to good Cymbidium culture. It is especially important to admit fresh air during the winter months to avoid a stale atmosphere while flower buds are developing.

Feeding: Cymbidiums are heavy feeders and most growers apply mild applications of organic or commercial fertilizers every two weeks during the growing season, from March through October.

Potting: Potting of Cymbidiums should be done immediately after flowering. At this time new growths are developing and the plants will have several months of cool weather in which to establish vigorous root systems before unfavorable summer conditions arrive. Cymbidiums do not like to be repotted, neither do they like small containers. It is advisable, therefore, to pot all mature plants in pots large enough to accommodate two or even three years of growth.

Many types of potting mixtures have been used successfully in Cymbidium culture; until now there have been as many Cymbidium potting mixtures developed as there are Cymbidium growers. Throughout the Middle West most growers are now using fir bark. Frequently a little sand, about one-eighth the total volume is added to the fir bark. The potting techniques described for Cattleyas apply also to Cymbidiums. After being repotted, plants should have reduced light and limited water (enough to prevent drying of medium), until a new root system has been established.

Garden and Home Culture: Year-round garden culture of Cymbidiums is possible in areas where the nights are cool enough for bud initiation yet where the temperature does not fall below 28°. Both pot culture and open bed plantings are possible in such areas. Where winters are colder, Cymbidiums can be placed out of doors from May through September. A lath house is an excellent outdoor growing structure for Cymbidiums, but, in lieu of a lath house, a good shade tree can be employed to shelter the plants in the cool, open air during the hot summer.

Cymbidiums cannot be recommended for home culture. Light, temperature, and humidity requirements are below optimum in the home and the plants quickly deteriorate.

THE ODONTOGLOSSUMS

The Odontoglossum group inhabits the tropical areas of the Western Hemisphere from Florida south to Argentina and is found growing from sea level to 12,000 ft. elevations. This group is the largest and most interesting one in the Orchid family. The flowers exhibit almost incredible variations which have made these fascinating orchids the favorites of many amateur orchid growers. The three most important cultivated genera in this group are the Oncidiums, the Miltonias and the Odontoglossums. Also many beautiful inter-generic hybrids have been made, particularly by European growers, who are the leaders in Odontoglossum hybridizing.

ONCIDIUM

Oncidiums grow well if potted in fir bark, although many species are natural creepers and horticulturists find that they do best when wired to a slab of tree-fern (Cibotium sp.) or allowed to grow up a tree-fern pole which is placed in the pot. Light, water, aëration and fertilizer requirements for most Oncidiums are similar to those stated for Cattleyas. The "warm" and "intermediate" Oncidiums grow and flower well at Cattleya temperatures; but the "cool" or high altitude members of this genus prefer night temperatures near 50° and day temperatures from 60° to 70°. The warm and intermediate Oncidiums will grow well out of doors in the summer if placed in a lath house or hung under a shade tree. A few growers have been successful in growing Oncidiums in the home, where

E. L. EVINGER

Oncidium Burgeffianum growing on a tree-fern raft.

E. L. EVINGER

Oncidium varicosum growing on a tree-fern pole.

they are usually cultivated like Cattleyas.

MILTONIA

The Miltonias, frequently called the "pansy orchids," are moderately cool growing Orchids. They grow well at the temperatures prescribed for Cymbidiums and under the light intensities prescribed for Cyps. Miltonias deteriorate rapidly in extreme heat; and, consequently, they are difficult subjects for areas with hot summers. They require copious watering during their vegetative period; but a damp stagnant atmosphere should be avoided for it encourages leaf spotting diseases which are common to Miltonias. Like the Cyps, the Miltonias prefer small pots. They should be repotted after flowering, using the methods and materials described for Cattleya potting. Miltonias will grow well in a shady and cool garden spot during the summer. They cannot, because of temperature requirements, be recommended for home culture.

ODONTOGLOSSUM

Most of the Odontoglossums are indigenous to high elevations in the Andes mountains, where they are found growing at altitudes from 8000 to 12,000 ft. These plants are extremely difficult to grow in any area where hot summer conditions prevail. They require night temperatures of 45° to 50° and day temperatures from 60° to 70°. "Odonts," like Miltonias, deteriorate rapidly under hot summer conditions; such innovations as evaporative coolers have made it possible to grow these lovely orchids in areas where previously they could not be grown. A few species of Odontoglossum (*Odontoglossum grande* and *O. citrosmum*) grow at low altitudes and these plants can be successfully cultivated with Cattleyas. Odonts require 2000 F.C. of light, about the same intensities as described for Cyps. The warm species should be watered like Cattleyas but the cool types require considerably more water and should never be allowed to become completely dry. Odonts require a moist atmosphere with an abundance of moving air.

Potting should be done immediately after flowering, providing that is not just preceding or during the warm season, in which case fall potting is recommended. Potting procedure is identical to that prescribed for Miltonias. Odonts belonging to the warm class adapt themselves readily to garden culture; but very few growers have successfully grown these plants in the home.

THE DENDROBIUMS

The Dendrobiums are in many respects the Asian counterpart of the American Odontoglossums, for there are over 1000 described species which are all extremely variable. Culturally, the Dendrobiums are divided into two groups—the evergreen types and the deciduous types. Each of these inhabits a specific geographic area and, consequently, has its own cultural requirements.

EVERGREEN DENDROBIUMS

As indicated by the name, the evergreen Dends retain their leaves and require no definite resting period. They require a night temperature of 60° and day temperatures above 70°. These orchids need high light intensities, almost daily waterings and bimonthly fertilizing during the growing season. They are very easy to grow and they produce an abundance of flowers. In the garden these Dends should be placed in a bright location and moved indoors before cool weather begins. Evergreen Dends will usually make excellent vegetative development under home culture; but the flowers are easily damaged by a dry, stagnant or gas-polluted atmosphere and as a result frequently fail to flower in the average home.

DECIDUOUS DENDROBIUMS

The deciduous Dends are grown precisely like their evergreen cousins when in vegetative growth. In late November or early December, however, they should be "rested" by lowering the night temperature to 50°. A cool corner of a Cattleya greenhouse where the temperature may go as low as 55° at night will suffice as a resting place. Watering should also be restricted and plants should only be soaked (pot-watered) once every two weeks. Such treatment will encourage flower bud development. As soon as the flower buds appear opposite the leaves on the previous year's growth, normal watering can be resumed and temperatures can be increased. While resting is not mandatory for flower bud development, it does encourage simultaneous development of all flower primordia which results in spectacular mass blooming. The deciduous Dends grow well in the garden during the summer months; but they prefer a more shaded location than the evergreen types. Home culture of these plants has not been too successful, principally because the cool requirements of the "resting" period cannot be satisfied.

Dendrobiums should be potted soon after flowering and just as the new growths begin to develop. They prefer small pots and grow well in fir bark. Many Dendrobiums can be propagated from vegetative "offshoots" which develop from buds located at the leaf nodes. When they are about three inches long these little plants can be removed and potted in small pots. They develop rapidly and usually flower in about two years.

THE VANDAS

Two important cultivated genera compose the Vanda group—Phalaenopsis and Vanda. Both are native to tropical Asia and are found in hot, humid climates.

PHALAENOPSIS

Phalaenopsis orchids require warm night temperatures no lower than 60°. Many growers raise night temperatures to 65° or 70° during the period of vegetative growth, from March to September. Day temperatures should be 75° or above. Drafts and rapid temperature fluctuations should always be avoided.

The light intensities prescribed for Cyps are equally applicable to Phalaenopsis. During the summer the light should be reduced to about 20 per cent of natural intensities. Less sheltering from light will be necessary during the Spring and Fall and none during the period from November through January.

Phalaenopsis, like the Cyps, have no water-storage organs and, consequently, should never be allowed to dry out. Plants can be pot-watered daily during the summer growing period and less frequently during the rest of the year. The atmosphere should be kept humid by periodically wetting down the walks and plant leaves, but this should be done early enough to permit leaves to be dry by nightfall for these orchids are very susceptible to leaf and crown rot. Phalaenopsis are heavy feeders and most growers fertilize with a water-soluble chemical fertilizer once every two weeks.

Air movement is very essential for good Phalaenopsis culture. A humid atmosphere without moving air, encourages pathogenic and insect diseases.

Phalaenopsis are best repotted after flowering. Large pots or pans which can be filled almost half full of broken pots or gravel should be used. Newly potted plants should not be thoroughly pot-watered until a strong new root system has developed.

Garden culture of Phalaenopsis during the summer months is possible, providing the plants are in a good shady location and receive sufficient water and fertilizer. Generally, home culture has not been possible with these plants, since the average home atmosphere is much too dry.

VANDA

Vandas will grow well with intermediate orchids if they are located in a warm sunny location in the greenhouse. Their temperature requirements are the same as those stated for Phalaenopsis; but they need high light intensities, as much as fifty per cent of outside light during the summer. An unshaded greenhouse during the winter months is necessary for good growth and flowering of Vandas.

Daily pot-waterings during the summer months are not excessive, although a more restricted watering schedule should be followed during the winter months. Vandas like a humid atmosphere and frequent wetting of walks and plant leaves, especially on sunny days will stimulate growth and flowering. In addition, Vandas are heavy feeders and a bimonthly feeding with animal or commercial fertilizers is desirable.

A well-aërated potting medium, which drains rapidly, is necessary for good Vanda culture. Many Vandas are grown in open wooden baskets. If fir bark is used for a potting medium, the large "chunk" grade is best since it will give adequate aëration and drainage. These orchids require large potting containers. As with other orchids, newly potted plants should be watered sparingly until a new root system is established.

Garden and Home Culture. A good sunny location is desirable for summer garden culture of Vandas; some growers acclimate their plants to full sunlight. However, most growers prefer some form of shading for outdoor culture. Vandas do not grow well in the home since light and humidity are usually inadequate.

BOTANICAL ORCHIDS

Sooner or later every orchid grower hears the name "Botanical" given some of the cultivated orchids. This term is applied to any orchid species or hybrid which is purely a collector's item and which has no general commercial or exhibition value. The number of these collector's items available to the botanical enthusiast is almost limitless, as most of the species in the Orchid family can be classified as Botanicals. Botanical orchids were very popular during the 19th Century and horticulturists considered them most desirable subjects for the orchid collection. During this period many fine botanicals were cultured in England and the United States. The early 20th century brought an expanding orchid cut-flower market as well as improved methods of orchid seeding culture which resulted in a tremendous emphasis in hybridization of commercial and exhibition type orchids. Today a rebirth of interest is developing in the long-neglected botanicals. Many orchid collectors are growing botanicals exclusively and others are realizing that some botanical orchids have flowers that are more distinctive and equally as charming as the flowers of the large, showy exhibition hybrids. The Missouri Botanical Garden has one of the oldest and most comprehensive botanical orchid collections in the Western Hemisphere. This collection is constantly being expanded and orchid collectors who are interested in botanicals will always find a number of these plants (collector's items) in flower at the Garden.

ORCHID DISEASES

Orchid diseases can be divided into three categories: environmental, pathogenic and insect diseases. Environmental diseases are caused by poor growing conditions where one or more environmental factor is not optimum. These deviations result in unhealthy and poorly grown plants. Pathogenic diseases are caused by the invasion of bacteria, fungi, or viruses into plant tissues; while insect diseases result from attacks by insects. Orchids are unusually hardy and remarkably free of the many diseases which attack most cultivated plants. Nevertheless, severe damage can quickly occur and recovery is frequently a lengthy process.

ENVIRONMENTAL DISEASES

An environmental disease may be thought of as a two-edged sword, for it not only weakens and retards the plant but it also opens avenues through which insects and pathogens can attack.

TEMPERATURE

Temperature regulates the rate at which plant physiological processes proceed and each orchid type has its own optimum day and night temperature requirements for each of the various phases of growth, flowering and fruiting. A 15- to 20-degree variation between day and night temperatures is usually normal for most orchids. Plants grown at below optimum temperatures are physiologically retarded and make weak, small growths. At temperatures above optimum, many orchids will not initiate flower buds, and they use up food (respire) faster than they can replace it. At extremely high temperatures, all photosynthesis (food making) stops, tissue burning may occur and even death result. Every effort should be made to keep plants cool during hot periods. Proper shading, aëration, watering and humidity are essential. Orchid flowers are also sensitive to heat and will keep longer in a cool environment.

LIGHT

Intensity: While optimum light intensities have been stated for the various major orchid groups, it must be remembered that the amount of light any individual plant can efficiently use is relative and dependent upon the general condition of the plant as well as other factors in the plant's environment. To illustrate: a Cattleya, growing in a decomposed potting medium, with a weak, under-developed root system, cannot possibly withstand 4000 F.C. of light and leaf bleaching or burning will occur. In contrast, a sister plant, in a fresh potting medium with a vigorous root system, will grow and flower profusely when receiving 4000 F.C. of light. Caution should always be exercised in moving plants from areas of low intensity into areas of high light intensity, for bleaching or burning of leaf chloroplasts may occur. Plants should always be gradually exposed to higher light intensities.

Quality. Intensity is not the only characteristic of light which can develop environmental disturbances in plants. Orchids should be grown under light which approximates, as closely as possible, the wave-lengths of natural light. Colored plastics and greenhouse shadings should be avoided, since photosynthesis can be severely restricted if certain essential light wave-lengths are reduced or absent.

Duration: An abnormal day length can have an adverse effect on flowering. Some orchids have flowering cycles which are so sensitive to day length that flowering will be irregular or completely inhibited by abnormal day lengths such as would be found in homes where lights are on every evening thus extending the photoperiod (day length).

Air Pollution

Orchid plants and flowers are particularly susceptible to polluted air. A small amount of illuminating gas in the air will quickly kill orchid blooms and can even cause plant defoliation and death. Industrial gases in the air can also affect orchid plants and flowers. Sepal wilt of Cattleya flowers is caused by polluted air and is frequently encountered in large cities and in industrial areas.

PATHOGENIC DISEASES

Bacterial, fungal and virus diseases do not usually attack orchid plants. Since these organisms, carried chiefly by man and insects, thrive in a damp, cool, stagnant atmosphere, they frequently infect plants growing in such areas. Bacteria and fungi usually appear as black or brown spots or as irregular black or brown areas beneath which the tissue has decayed (necrotic areas). Some of the fungus diseases spread rapidly through succulent plant tissues and a plant can be killed within several days. At the first appearance of any of these symptoms, the infected tissues should be removed by surgery. Greenhouse humidity should be lowered, overhead sprinkling of leaves suspended and infected plants watered sparingly. If possible, infected plants should be isolated. If this procedure does not check the infestation, spraying with a commercial fungicide may be necessary.

Virus diseases are a special problem, since they are systemic and consequently affect the entire plant. Furthermore, any division separated from an infected plant will also be infected. A plant can not be cured of virus. Virus diseases usually appear as irregular light-colored fleckings or streakings which may later turn black. The general vigor of the plant is usually affected and new growths may be retarded. Viruses can be transmitted easily by man and insects, therefore infected plants should be isolated or destroyed.

INSECTS AND OTHER PESTS

Orchids are subject to attack by several insects, the most common of which is orchid scale or Boisduval's scale (*Diaspis Boisduvalli*). This insect will attack any part of an orchid plant. It usually collects in irregular fluffy white colonies which are frequently found under the dry pseudobulb sheaths where they cannot be seen or easily killed by conventional spray methods. Keeping the sheaths removed will prevent heavy infestations of scale insect. DDT, Malathion, or Parathion are all very effective against orchid scale. This insect can easily build up resistance to one or more of

A heavy infestation of orchid scale on the pseudobulbs and stems of a Cattleya hybrid.

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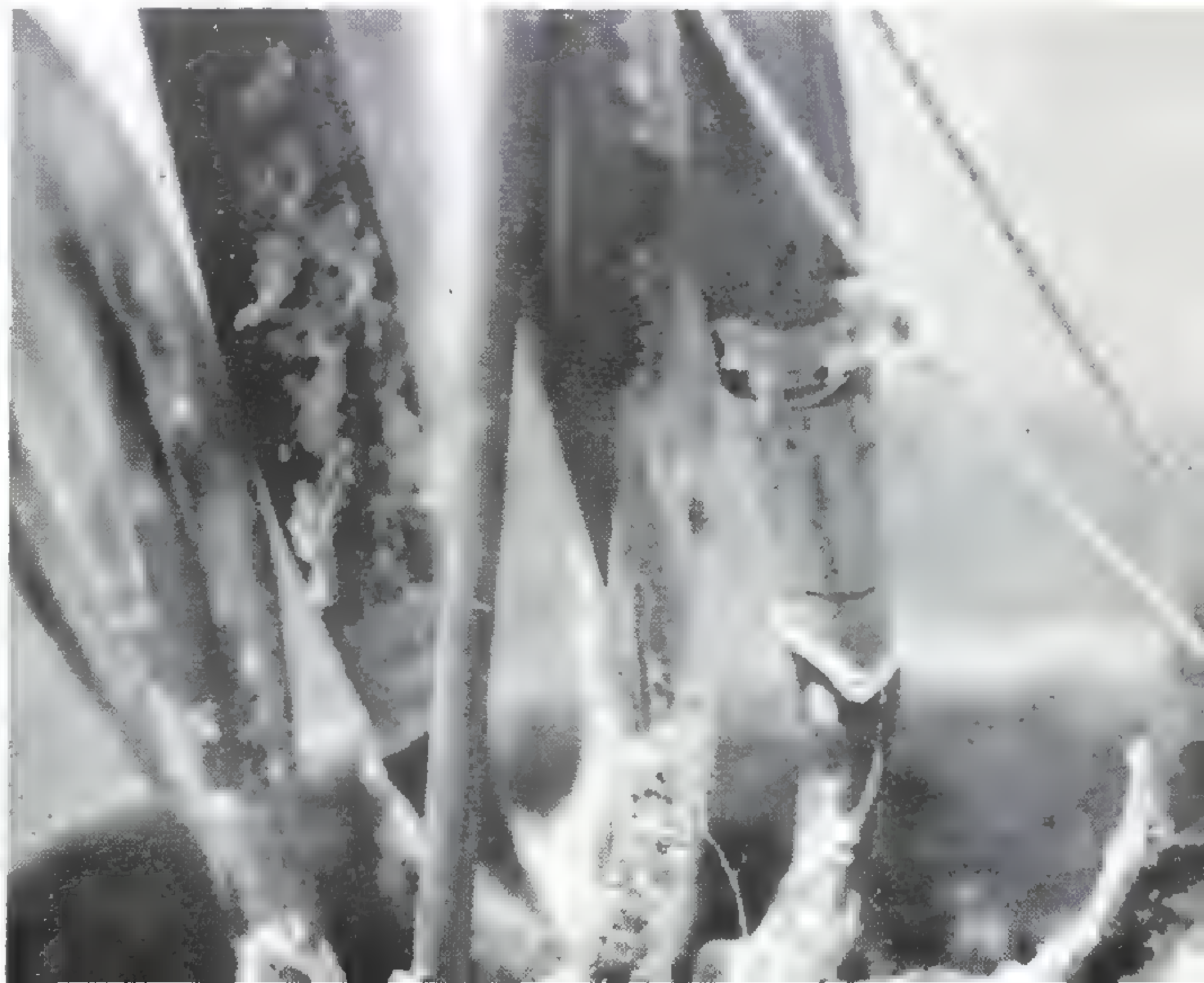

these sprays, therefore it is not advisable to use any one of them exclusively.

Thrips (*Euthrips orchidii*) is another insect which preys on orchids. It feeds on tender young growths by rasping away the epidermal tissue and sucking the plant juices. This insect is extremely minute, averageing $\frac{1}{32}$ to $\frac{1}{16}$ of an inch in length. Thrips move very rapidly and many growers are completely ignorant of their presence. Like scale, thrips can be exterminated with DDT, Malathion or Parathion.

Red Spider (*Tetranychus bimaculatus*) is a frequent pest on orchids. This small red mite lives on the underside of leaves where it sucks plant juices and produces a characteristic small white speckling on the underside of the leaf. This is one of the most difficult pests to eradicate for it is difficult to detect, it multiplies rapidly and it frequently develops strains which are resistant to specific poisons. Numerous commercial pesticides are on the market which are especially designed to kill Red Spider.

Slugs, Cockroaches, Sow Bugs and Springtails are scavengers which are frequently encountered in the greenhouse. These animals are usually nocturnal and live on decaying vegetable material but they also attack orchid flowers and succulent vegetative growths. Slugs can be controlled through the use of poison baits or by spraying or dusting with commercial slug-killing preparations. Cockroaches, Springtails and Sow Bugs are all easily controlled with chlordane sprays or dusts.

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ORCHID CULTURE CHART

Genus	Light Summer* (foot candles)	Temperature (degrees F.) Day	Temperature (degrees F.) Night	Watering** Summer	Watering** Winter	Fertilizing Summer	Fertilizing Winter	When To Pot***	House Plants	Summer Garden
Cattleya	3000	70–85	60	3	2	Monthly	None	On new roots	Rec.	Rec.
Warm Cyps	2000	70–80	55–60	Daily	3	Monthly	None	After Flower.	Rec.	Rec.
Cool Cyps	2000	70–75	50–55	Daily	3	Monthly	None	After Flower.		
Cymbidium	4000	70–75	50–55	Daily	3	Bi-Month.	None	After Flower.		Rec.
Oncidium	2–3000	60–75	50–60	3	2	Monthly	None	On new growth	Rec.	Rec.
Miltonia	2000	70–75	50–55	3	3	Monthly	None	After Flower.		Rec.
Odontoglossum	2000	60–75	45–69	Daily	3	Monthly	None	After Flower.		Rec.
Evergreen Dends	4000	70–85	60	Daily	3	Bi-Month.	None	On new growth		Rec.
Deciduous Dends	3000	70–85	50–60	Daily	3	Monthly	None	After Flower		Rec.
Phalaenopsis	2000	75	60–65	Daily	3	Bi-Month.	Monthly	After Flower		Rec.
Vanda	4000	75	60–65	Daily	3	Bi-Month.	Monthly	Anytime not flowering		Rec.

* No shading is necessary during the winter months.

** Number indicates times per week.

*** Fir bark is recommended as the most practical potting medium.

Rec. Abbreviation for recommend.

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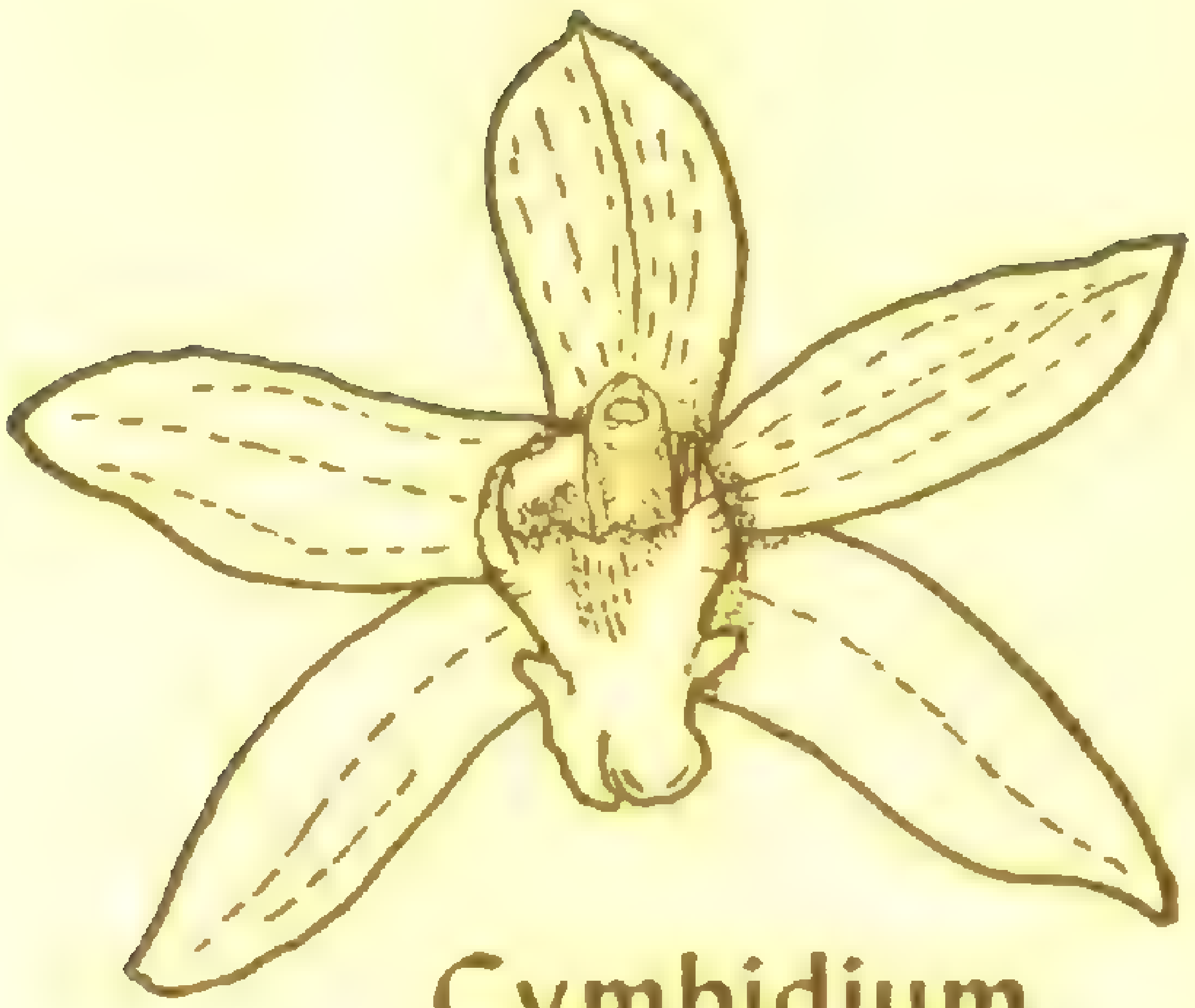
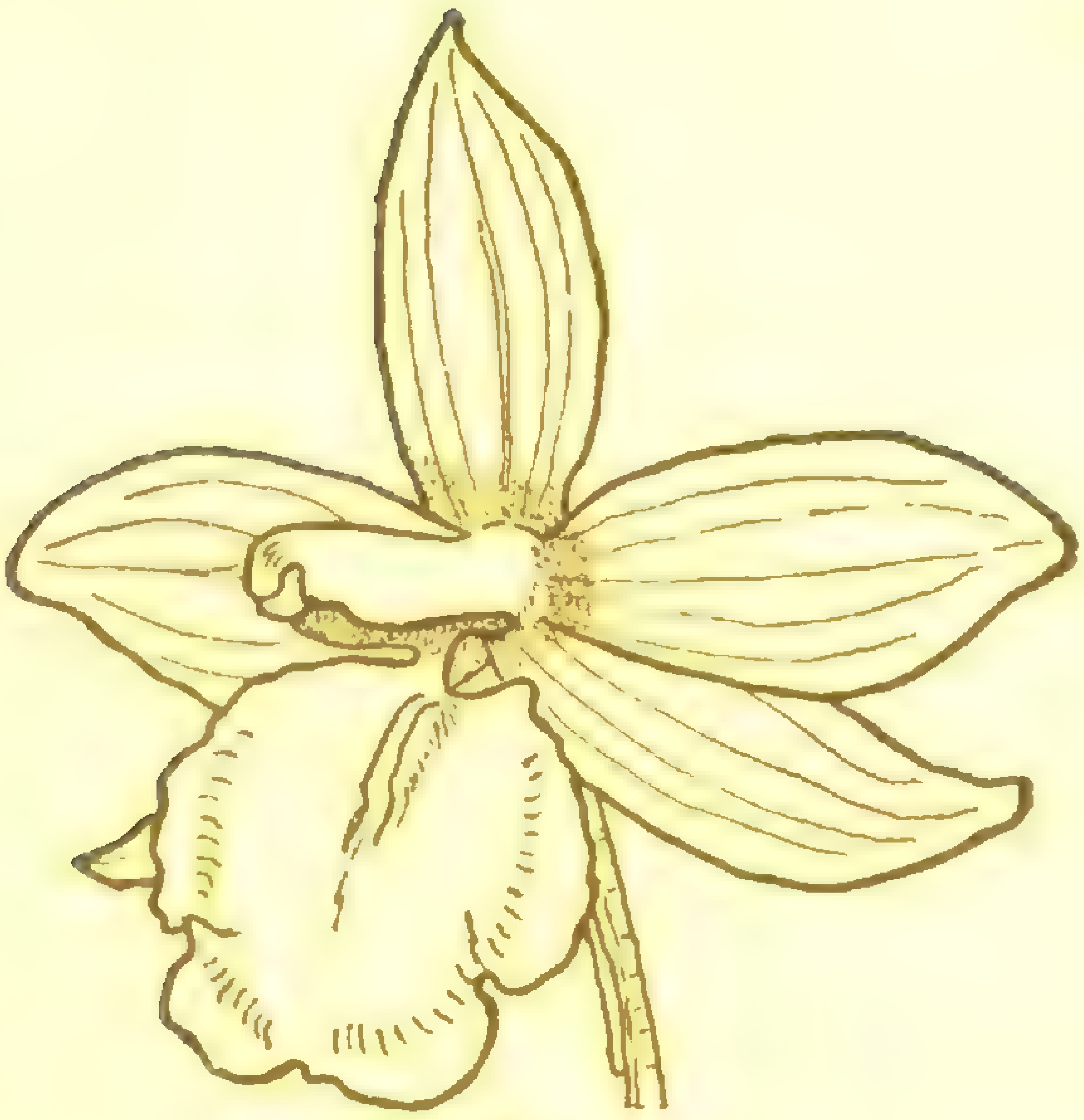
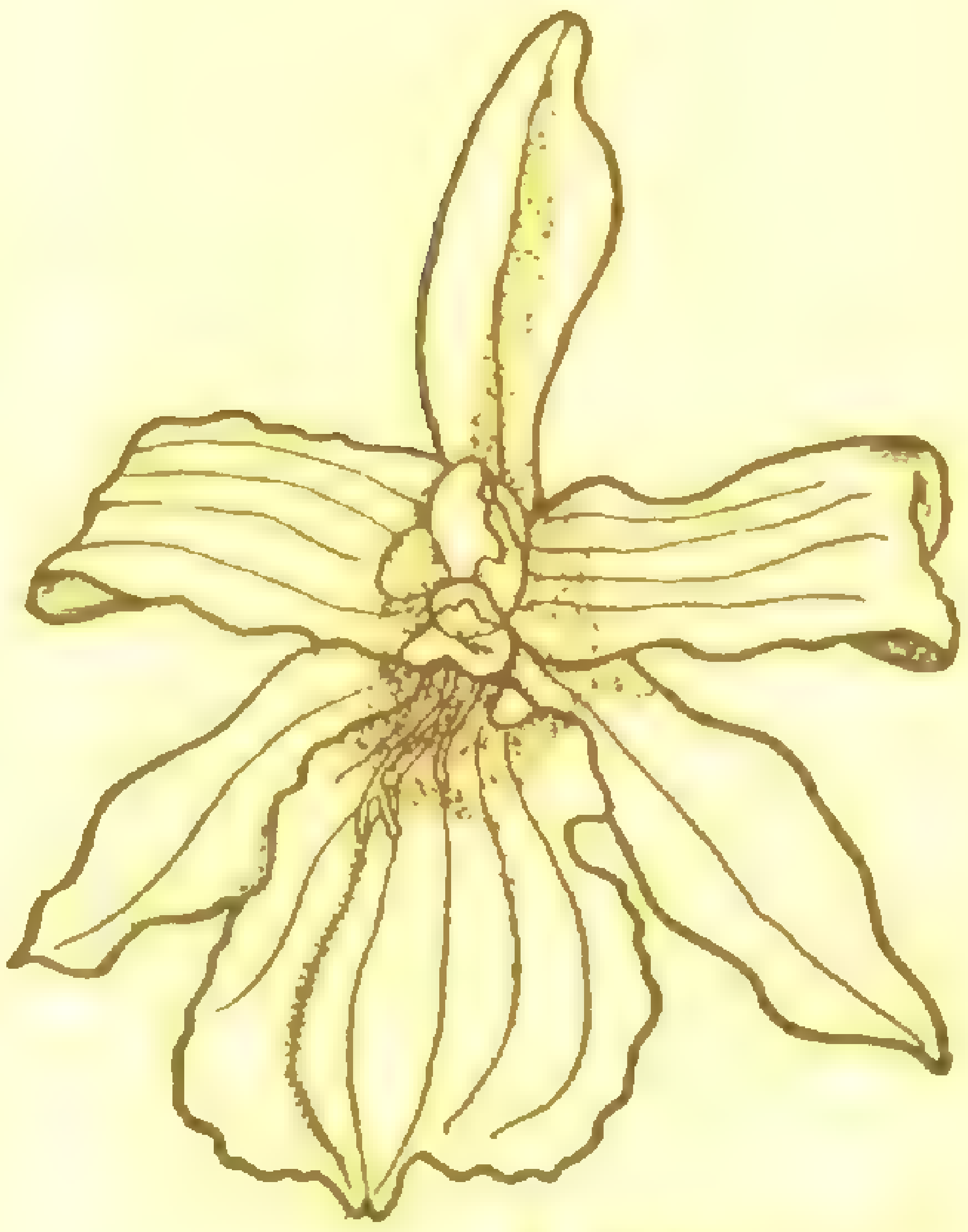


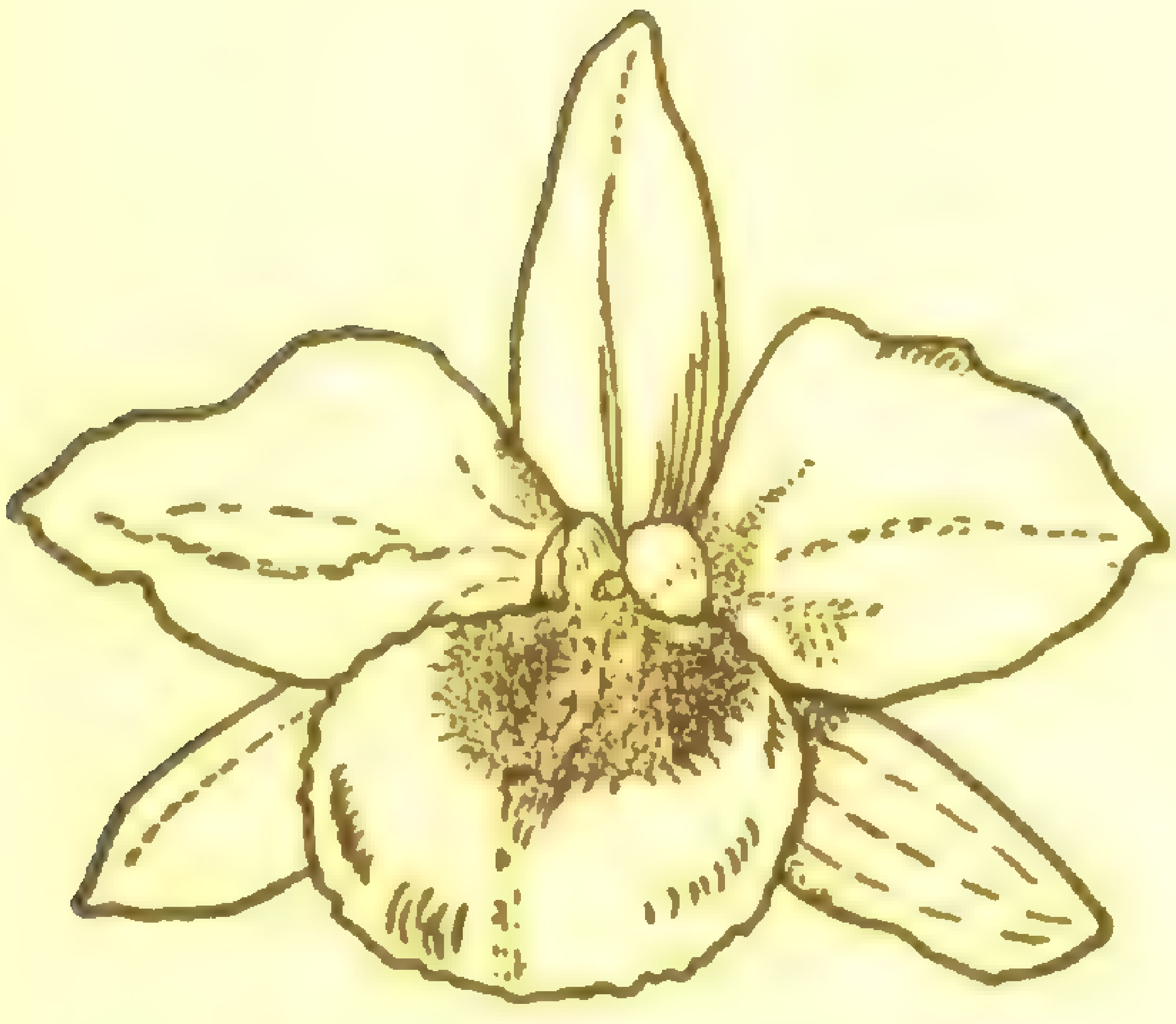
Cymbidium



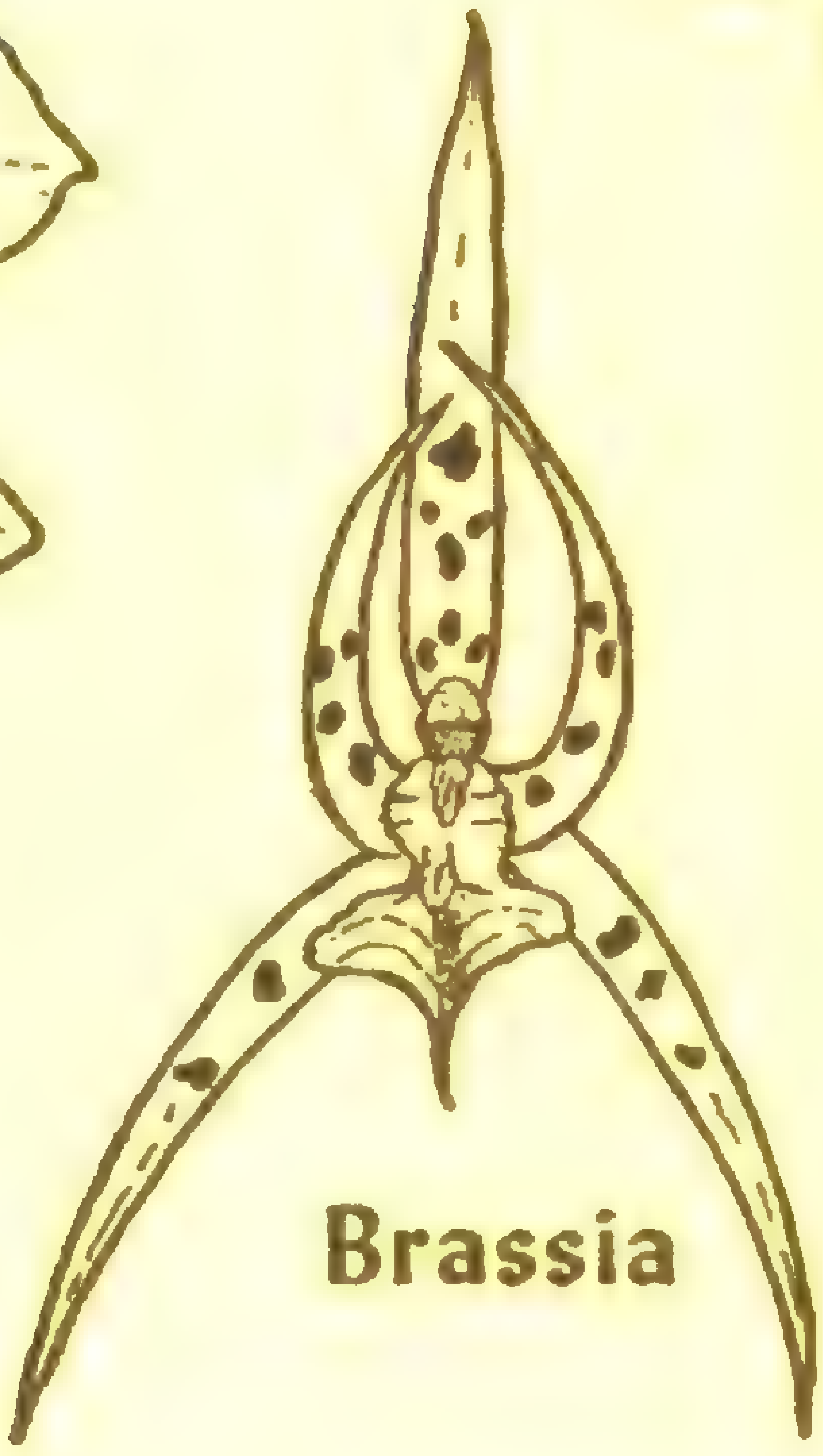
Phaius



Miltonia



Dendrobium



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MISSOURI BOTANICAL GARDEN

Bulletin

Volume XLVII
March, 1959
Number 2

CONTENTS

The Missouri Botanical Garden in 1958

MISSOVRI BOTANICAL GARDEN
1889

COVER: A group of children in rapt attention as Mr. Kenneth Peck instructs them in how to identify the different kinds of trees by their leaves. Photo by Paul Hodges, courtesy *Globe-Democrat.*

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MISSOURI BOTANICAL GARDEN BULLETIN
Vol. XLVII No. 2 March, 1959

THE MISSOURI BOTANICAL GARDEN IN 1958

F. W. WENT AND HUGH C. CUTLER

THE upward swing of the last few years in the activities of the Missouri Botanical Garden has continued during 1958. Several new appointments were made, garden maintenance was increased and the educational program was expanded, all as a result of increased support from Friends of the Garden and from special and other grants. These advances were reflected in the increased attendance and the excellent spirit of the employees. Yet, much more remains to be done before the Garden is back to its prominent position of the early part of the century.

A number of important changes were made during the year. One of them was the moving of our large and significant orchid collection from the Arboretum at Gray Summit to the greenhouses in the Garden. When the smoke nuisance in St. Louis had become so great that the orchids were seriously damaged, a set of greenhouses were constructed on the newly acquired land at Gray Summit, 30 miles west of St. Louis, and in the summer of 1926 most of our orchids were transported from the city greenhouses to the new range. In his 1926 report Dr. Moore said "although these plants have been in their new environment less than six months, the improvement in growth is little short of phenomenal. Their removal from the influence of the poisonous gases of the city . . . [has caused an] increase in the growth and the health of the orchids so great as to justify the belief that within a few years the Missouri Botanical Garden can compete with the orchid world, not only in quantity and variety, but also in the quality of plants."

Mayor Raymond R. Tucker and the orchid named in his honor, *Cattleya × Mayor Tucker*. Photo courtesy *Post-Dispatch*.

All of us were watching with great interest (and some misgivings) the outcome of the move back to the city during the spring months—February to July. Thus far it seems that most plants have tolerated the now-clean city air without setbacks and our orchids are in excellent condition. As a token of appreciation of the Garden for our regained clean air a new Cattleya hybrid produced at the Garden was named "Mayor Tucker" for his magnificent fight and signal success in combatting and conquering the St. Louis smoke problem.

Some fans and evaporative coolers have been installed in the greenhouses now occupied by the orchid collection to keep temperatures in those houses down during the hot summer. Yet some plants, such as the Miltonias, are suffering from high temperatures, which are higher in town than at Gray Summit.

Another important improvement at the Garden was the extension of the educational program. Both Dr. Norton H. Nickerson and Miss Josephine Davies have joined our staff in the education department this year. The number of courses now offered at the Garden has been increased, and a new children's program for Saturday mornings has been started. The Pitzman Nature Program proved to be very popular, and a total of 230 children received certificates for completing the two 5-week study courses.

This year we had a grant of $30,000 from the National Science Foundation for rehabilitation of Herbarium and Library and a similar amount has been granted for 1959. Dr. Robert E. Woodson, appointed Curator of the Herbarium, and Dr. George Van Schaack, now Librarian, have been active in rearranging offices and collections to make them most effective.

The Systematics Symposium was held on October 24 and 25 and was, as in previous years, a great success. A total of 227 scientists from 61 institutions registered at the Symposium which, because of its size, could not be held in the Museum Building. Instead, the Floral Display House was transformed into a meeting room where, under the joint chairmanship of Dr. Edgar Anderson, Curator of Useful Plants at the Garden, and Dr. Robert L. Usinger, Professor of Entomology at the University of California, a total of 5 talks on the general theme of "Taxonomic Consequences of Man's Activities" stimulated lively discussions. At noon on Saturday a buffet style luncheon brought the participants together in informal discussions. The previous evening, refreshments were served at a Smoker in the Museum Building from 7 to 10 P. M.

Six members of the Board of Trustees accompanied Dr. Went and Dr. Cutler on a trip to botanical gardens in the Eastern United States, for the purpose of studying botanical garden problems in other localities. The fabulous Longwood Gardens, maintained by the Pierre Du Pont Estate (the Longwood Foundation), aroused our envy because of the apparent absence of financial problems. Their displays of flowers and plants are unrivaled. It was gratifying to see there the extent of influence of the Missouri Botanical Garden in horticultural matters. A set of heated waterlily pools were constructed to display tropical water lilies—many of them hybrids developed here by Mr. Pring. The Director, Dr. Russell Seibert, is a former student and staff member of our Garden.

Visits to the New York and Brooklyn Botanic Gardens indicated the degree of tax support so many of our most prominent botanical gardens receive without being hampered by political interference. Of special interest were the restoration of the Lorillard Snuff Mill, now made into a most attractive restaurant, and the large research laboratory, just completed, both at the New York Botanical Garden, and the educational facilities at the Brooklyn Botanical Garden.

Other educational visits were made by a number of the Garden employees to the Morton Arboretum, the Chicago Natural History Museum, and Garfield Park Conservatories in Chicago.

No report on the activities of the Garden would be complete without reference to a number of supporting organizations. The Friends of the Garden are becoming increasingly important as a source of financial and moral support and as a group of persons ready to help in other respects. At the end of the year they numbered 2,520, and income from memberships amounted to $29,795.06. The Women's Association of the Garden organized a membership drive which resulted in an increase in membership of 287. Several additions to the Garden staff became possible through the increased income from these additional memberships. Also through the Friends of the Garden a publicity head is employed at the Garden.

The Women's Association has increased its activity. Its members have helped maintain the Shaw Tower Grove country house, and have redecorated the Director's Office with telling results. Whenever a demand for help was directed to them they rose to the occasion.

The Horticultural Council has, as in previous years, been helpful in Garden matters, in supplying materials (for instance, for the Rose Garden, which was more beautiful than ever in 1958) and in helping with labeling plants.

Photo by Roy Cook, courtesy *Globe-Democrat.*

Letters soliciting new members for Friends of Garden are checked before mailing by officers of the Federated Garden Clubs of Missouri. They are, from left: Mrs. Earl H. Hath, board member, Mrs. Campbell Alexander, assistant director of East Central district, and the director, Mrs. Hazel L. Knapp.

THE GARDEN, PAST AND FUTURE

Now, at the end of the first century of existence of the Missouri Botanical Garden, it seems fitting to take a look backwards, and to see to what extent the Garden has fulfilled the wishes of its creator, Henry Shaw.

In his will, written in 1885, four years before his death, Shaw stressed three functions of the Missouri Botanical Garden. They should be:

1) "having for the use of the public a Botanical Garden easily accessible, which should be forever kept up and maintained for the cultivation and propagation of plants, flowers, fruit and forest trees, and other productions of the vegetable Kingdom; and a museum and library connected therewith, and devoted to the same and to the science of Botany, Horticulture, and allied objects."

"The director . . . shall employ his energies, that from year to year the institution under his charge shall grow up in efficiency in promoting the ends in view in its inception."

2) "I declare my intention that instruction to garden pupils shall be attended to, both in practical and scientific, horticulture, agriculture and arboriculture, and consider it an important feature to always keep up the ornamental and floricultural character of the garden."

3) "I also declare that scientific investigations in Botany proper, in vegetable physiology, the diseases of plants, the study of the forms of vegetable life, and of animal life, injurious to *to* vegetation, experimental investigations in horticulture, arboriculture, etc., are to be promoted no less than instruction to pupils."

In addition, his will stresses the ties Shaw hoped there would be between Washington University and the Garden; with this particular idea in mind he established a School of Botany at the University.

In many respects the Garden has realized the hopes and expectations of Henry Shaw. It has become not only locally, but also nationally and internationally known. Local interest centers around the garden, greenhouses, and the frequent flower shows, which attracted 250,000 in 1958.

The educational aims of Henry Shaw, especially in the field of scientific Botany, have been clearly achieved in the past years, and it is gratifying to look over the long list of botanists who have received their professional training at the Missouri Botanical Garden. The Garden offers ideal conditions for the training of practical gardeners; and the training for other professions, such as landscape architect, also requires the facilities of a great botanical garden.

Education of children and of amateur gardeners has been particularly stressed during the last years. Gardening and plant growing are among the most rewarding of leisure time pursuits, and thousands of people get a great satisfaction out of learning more about nature by observing it at first hand. The Garden is the logical place to help in these activities, to provide information, import materials and educate to observe and record properly. It is gratifying to hear over and over again how visits to the Missouri Botanical Garden as a child have shaped the interest in plants of so many persons, now recognized botanists, gardeners, or nature lovers.

Development of an organization can only be effective when it is clearly understood what goals have to be achieved. As indicated earlier, Henry Shaw, through his botanical advisors, had a very good idea of what should be accomplished. Development of the Garden actually followed these ideas rather closely.

Now, one hundred years since the founding of the Garden, it is necessary to re-evaluate the original aims in relation to present-day requirements, and to map a course of action, which does not necessarily have to be followed, but which indicates desirable and possible ends. For this reason work has been started on a Master Plan for development of the Garden. Funds for this Master Plan in the amount of $25,000 were provided by the Greensfelder Foundation. The firms of Layton, Layton and Rohrbach, landscape designers, and of Murphy and Mackey, architects, were retained for this Master Plan development.

Compared with last century, attendance at the Garden has increased manyfold and the subsequent development of the automobile necessitates close attention to parking needs and avenues of access. Modern developments in greenhouse construction, especially as regards air conditioning, pose new problems. The almost explosive interest in basic science is another aspect to be considered in the development of the Garden during its second century.

Since its inception many centuries ago, the botanical garden has changed from a simple collection of medicinal plants into a general institution, encompassing

1) living collections, often augmented by a museum of preserved materials

2) facilities for flower shows

3) a herbarium and library

4) a horticultural center, bringing gardeners and scientists together

5) an information center for all plant information

6) a research center, involving botanical and horticultural research

7) a center for plant introduction and for testing of new materials

8) a breeding center, to produce better plants for local conditions

9) a training center for gardeners

10) the teaching of children and adults, both on a professional and an amateur basis

11) the publication of information on plants

12) lectures, being a general center of intellectual activities

13) a good environment for the special interests of historians

Within this framework we will consider some of the activities we must provide for in the Master Plan of our future development.

All greenhouses are old (40–50 years) and for many years were in poor repair. Some of them, such as the Succulent House, the Floral Display House, the Linnean House and the Plant Curiosity Houses were reconditioned and can now be operated satisfactorily for several more years, but the growing houses, the Fern and Economic Houses and the Citrus House are in such condition that repairs are not warranted any more. The Palm House also would need extensive rebuilding at a prohibitive cost.

With the exception of the boiler house, which is in good condition (except for the oldest of the three boilers), the service facilities are so poor that complete rebuilding is necessary.

Taking all these facts into consideration, the Master Plan in its preliminary form envisages a complete set of new greenhouses, all interconnected for convenient circulation of the public. These greenhouses will be air conditioned, making it possible to grow plants from all parts of the world, and to keep the plants we now possess under the most advantageous growing conditions. Whereas the importance of air conditioning of greenhouses for scientific studies has been amply proven, it is expected that the air conditioning of the new display house will start a completely new trend, to be followed by botanical gardens and parks all over the world.

Parking space, now not available in the Garden for visitors, will be provided through a parking lot to be contructed at the north-east corner of the Garden, with access from both Tower Grove and Shaw Avenues.

Preliminary plans were prepared for an addition to our research facilities, and an application was made to the National Science Foundation for funds for this addition. This addition, in the form of a wing on the present herbarium and library building, will contain the research rooms for the taxonomists, laboratories for physiologists and ecologists, library space for our most valuable books, a reading room and book stack space, and Director's and Executive Director's Offices.

The grounds are to be developed into special gardens and ecological groupings, using especially the horticulturally most important materials for the St. Louis area. At the same time the park aspects will be developed, with emphasis on the most spectacular flowering plants.

All the other activities of a complete botanical garden, mentioned earlier, are considered in the Master Plan development. Display areas for flower shows, a lecture hall, an entrance building with information center and offices for horticulturists, a school and research building, staff housing and a restaurant are all parts to be fitted into the complete Master Plan of the ideal botanical garden. The entire staff of the Missouri Botanical Garden, from gardener to director, stand ready to implement the Master Plan, and to develop the garden, if possible, even beyond the dreams of Henry Shaw. To this end we need the very active support of the whole St. Louis community.

* * *

THE HERBARIUM

A grant from the National Science Foundation is permitting the first major improvement of the herbarium quarters since the present building was erected in 1907. New fluorescent lighting and additional herbarium cases are being installed. The floors have been resurfaced and the unspeakably dreary brick interior walls will be camouflaged with vinyl paint in attractive shades. The ramshackle chairs and desks, which have been falling apart for some time, will be rehabilitated or replaced. In short, before the year is out, the quarters of the herbarium will appear very much more in keeping with its hard-earned prestige and the value of its famous collections.

But inadequate space presents increasingly grave problems not only restricting the necessary growth of the collections but depriving the staff of equally necessary processing and research rooms. Not only has no additional space been available for the herbarium during the past 30 years: within the past five years it has lost over 10% of its former space (in the Shaw House and the Museum Building) to other projects. As a result, until the past summer all the processing of our herbarium collections was confined to a room approximately 20 feet square! About 50% additional space for processing recently has been obtained through a leger-de-main of compression made possible by the National Science Foundation grant. For the herbarium of the Missouri Botanical Garden this temporary relief is a godsend: for another museum of equivalent size it would be ridiculous. The crisis of the Missouri Botanical Garden is that of the City of St. Louis and of all living things—if it cannot grow, however slowly, it will die.

As for some years past, taxonomic research in the herbarium has centered largely about the compilation of the Flora of Panama, a project also supported by the National Science Foundation. During 1958 three fascicles of the Flora were published in the Annals of the Missouri Botanical Garden, including families Passifloraceae through Melastomataceae of the Engler system. Two additional fascicles are scheduled for 1959. In addition to his compilation of the Flora of Panama, Dr. Woodson has continued his studies of population structures in *Asclepias tuberosa.* Dr. Dodge has continued his studies of Antarctic and tropical African lichens, and Dr. Dressler has pursued various topics in Euphorbiaceae and Orchidaceae.

Dr. John D. Dwyer, Research Associate at the Garden and Director of the Department of Biology, St. Louis University, using the research facilities of the Garden herbarium.

Photo courtesy THE EDUCATIONAL FOCUS.

Six graduate students of the Henry Shaw School of Botany of Washington University have conducted their research in the herbarium during 1958 two of whom, Miss Kay Raeder (A.B., Pomona College) and Donald G. Rhodes (B.S., Southeastern Missouri College), received the degree of A.M. at the June commencement. Presently resident graduate students and the families of their dissertation research are: Lorin I. Nevling, Jr. (A.B., St. Mary's College; A.M., Washington University)—Thymelaeaceae; Henry J. Kaltenthaler (B.S., Pennsylvania University; A.M., Washington University)—Rubiaceae; William C. Burger (A.B., Columbia University; A.M., Cornell University)—Moraceae; Howard Pfeifer (A.B., State University of Iowa)—Aristolochiaceae.

A heartbreaking loss to the herbarium and the Garden as a whole was sustained by the death in September of Miss Margaret Carroll, for a number of years the herbarium secretary. Miss Carroll's duties have been transferred to Mrs. Irene Buersmeyer who formerly was employed at the Naturmuseum Senckenberg, Frankfurt, Germany.

Herbarium Records—1958

Specimens accessioned: 807 sheets from 8 institutions

Specimens mounted: ca. 5,000 sheets

Exchanges sent: 1,161 sheets to 8 institutions

Exchanges received: 4,599 sheets from 17 institutions

Loans sent: 7,161 sheets to 32 institutions

Loans received: 1,113 sheets from 11 institutions

Approximate total specimens in the herbarium: 1,717,160 sheets

* * *

RESEARCH IN USEFUL PLANTS

Four graduate students in the Henry Shaw School of Botany have spent part of their time carrying on research work under the guidance of Dr. Edgar Anderson, Curator of Useful Plants. Mr. Hugh Rouk, who has been engaged in research, teaching, and administration in Ethiopia for the last six years, is back in the United States for a Sabbatical year and is carrying on basic research on variation in wild and semi wild Ethiopian coffees. Mrs. Erna Eisendrath has continued her investigations of Polianthes and of the history of botanical illustration with particular reference to the Garden's splendid collection (started by Henry Shaw) of 17th and 18th century illustrated monographs ("botanical Icones"). Mrs. Hazel Rouk has begun graduate studies in botany and is studying Ethiopian spices under Dr. Anderson's direction. Mr. William L. Murdy, who has been working jointly on fossil plants and maize has spent the major portion of the year analyzing variation in the stiffening and supporting tissues of the maize plant under the direction of Dean Henry N. Andrews, Jr., of the Henry Shaw School of Botany, and Dr. Anderson.

Dr. Anderson and Dr Hugh C. Cutler, Executive Director, have both continued actively in their research programs related to prehistoric and modern maize. The National Academy of Sciences' Maize Committee (of which they are both members) devoted

Photo by Dick Coffin.

Mr. Michael J. Wynne examining and measuring specimens of prehistoric maize.

to collecting and describing the multitudinous varieties of maize in the New World, is now drawing its international project to a close. Mr. G. Edward Nicholson Calle, Fellow of the Guggenheim Foundation for 1958-59, was in St. Louis working with Dr. Anderson and Dr. Cutler before spending two months in South America where he undertook various jobs for the Maize Committee in Bolivia and Columbia. Dr. Anderson spent somewhat over a month in Bogotá, Colombia, during the summer on the same project. In November the Garden was official host for one day to a group of scientists who are engaged in this maize project.

Dr. Cutler, with the support of a National Science Foundation grant is continuing with the description and identification of the world's collections of prehistoric maize, aided by his technical assistant, Mr. Michael J. Wynne. Mr. Wynne was a winner in the 1958 National Science Fair competition, where he exhibited some of the material with which he has been working at the Garden. He is now an undergraduate at Washington University, majoring in Botany. During most of the summer, Mr. Robert Bird, as part of his work in botany at Cornell University, worked with Dr. Cutler and Dr. Anderson on projects in the field between Botany and Anthropology.

LIBRARY

In addition to its normal activities the library undertook an extensive binding program and considerable rearrangement of quarters. These projects, largely made possible by a grant from the National Science Foundation, will put hundreds of valuable but previously unbound volumes in good condition for preservation. The change in quarters provides better working space both for users of the collections and for those caring for them. In particular, the major bibliographies have been relocated with the card catalog in a new and more convenient area. Book purchases for the year were much greater than in the recent past, several important journal sets being completed and other large treatises obtained. But all this is only an initial attack upon the large backlog of incomplete files, inadequate shelving and poor physical condition of the collections. In particular, our very valuable rare book and folio collection is still most inadequately shelved, with many books in desperate need of rebinding or other major repair.

EDUCATION PROGRAMS

Much activity has been provided during the past year for school children 7 to 19 years old. During the Spring and Fall, an estimated 8000 children and adults walked the Tree Trail. In the Summer months, the Pitzman Nature Program offered four courses in the natural sciences covering birds, animal and insect enemies, trees, and other plants. Two 5-week sessions were offered and of the 350 children who attended, 60% registered for all four courses. Individual classes contained as many as 65 children, and were instructed by officials of the St. Louis Audubon Society and Garden Staff members. (See Cover.)

In October, 535 children from neighboring schools received instruction on bulb culture. Each student was given two Paperwhite Narcissus bulbs to plant and take home.

The newest education program, which started in December, offers Saturday morning activities for children. This program will be scheduled for every Saturday morning of the year and covers many phases of botany and horticulture. The weekly attendance average in December was 70 children. No fee was exacted for any of these activities.

For adults, courses in bulb forcing, plant propagation, horticulture, spring flowers, orchid culture, and technical botany were taught by Clarence Barbre, Dr. Edgar Anderson, Robert J. Gillespie and Dr. Norton H. Nickerson, and other members of the staff.

* * *

ORCHID DEPARTMENT

During 1958 the orchid collection was moved from Gray Summit back to the city Garden. The actual moving of plants began in February and was completed in July. The move was made under the direction of Robert Gillespie, in Charge of Orchids. Arranging and organizing the collection in town occupied the orchid staff during the remainder of the year. Elimination of duplicate plants reduced the number of plants to about one third the number formerly kept at Gray Summit. A large number of valuable plants new to our collection were acquired during the year, including a group of 56 new "botanical" species. The collection now has more genera and species than ever before.

The Cattleyas, Cymbidiums, Paphiopedilums, Dendrobiums, Vandas, and most of the "Botanicals" seem acclimated to the new location and have produced excellent vegetative growths and flowers.

Dr. Hugh C. Cutler (left), executive director of the Garden, and Lad Cutak, greenhouse superintendent, unload orchids which are being moved back to the city from the Arboretum at Gray Summit.

Photo courtesy *Globe-Democrat.*

The 1958 Orchid Show was one of the largest orchid shows ever staged by the Garden. A massed bank of Cattleyas provided the brightest color spot but interest of the many visitors was centered mainly on the large collection exhibited for the first time by members of the Orchid Society of Greater St. Louis, and the large and unusual display of orchids from the Garden's collection.

PLANT INTRODUCTIONS

Between four and five hundred species and/or varieties of hardy outdoor plants are now growing in the Experimental Greenhouses and nursery. During 1958, approximately two hundred and twenty-five new species were received as seeds, cuttings or plants from exchanges, gifts, and purchases. Many of these plants have been propagated and will be selected for trial for hardiness, growth characteristics, and for experimental study. The most promising plants will eventually be incorporated in the Garden for display. More than one hundred new plants or replacements were planted in permanent locations in the Garden during the Spring and Fall planting seasons of 1958. The plant introduction and trial work is carried on by Horticulturist Ed Evinger.

GREENHOUSES

All greenhouse and display activities are under the direction of Greenhouse Superintendent Ladislaus Cutak. Plantings in the main greenhouse range were replanted and thinned because some of the plants were spreading out of bounds. This work was done by Al Mielczarek. Fog systems for cooling and raising humidity were installed in some of the Exotic Houses for the orchid collection from Gray Summit. One of the sheds adjoining the Display House was renovated to serve as an Orchid Laboratory by scraping and painting the walls, installing electric lighting system, and constructing benches and shelves.

The house formerly used for citrus trees is now used for the plants grown by the Greater St. Louis Chrysanthemum Society for their exhibit in the annual Chrysanthemum Show.

The waterlily collection, which forms an outstanding attraction during the summer months in the outdoor pools, required a great deal of preparation in the early part of the year. The propagation of waterlily tubers starts in January and continues for several weeks until several hundred potted plants are obtained for our own use. Nearly a hundred lilies are needed to adequately plant the pools. A preseason display of waterlily blooms was kept open during April in the indoor tanks. The waterlilies were planted outdoors on May 12th and remained in the pools until late October.

The rockery in the old Curiosity House was torn down to make an effective staging for orchid displays.

EXHIBITIONS AND FLOWER SHOWS

The number of shows and the extent of our displays continue to grow.

Photo by Paul A. Kohl.

The 1958 Chrysanthemum Show in the Floral Display House.

Some of the more important displays were of poinsettias, orchids, azaleas and other spring flowers, hydrangeas, and chrysanthemums. Competitive shows were held for daffodils, African violets, roses, spring flowers and vegetables, cacti, fall flowers and garden products, and dahlias. A constant succession of interesting flowering material is shown in attractive settings in the Display House and adjacent greenhouses. While most of the work for competitive shows is done by the societies which stage them, there are many jobs connected with these which must be performed by the greenhouse and grounds crews. A new event in our Display House was the Junior League Show "Master Cat," which was given for children on October 18th and was well liked. Flowers grown at the Garden were taken to Christ Church Cathedral for the annual Henry Shaw Flower Sermon given April 20th by Rev. Theodore O. Wedel, Canon of Washington Cathedral and Warden of the College of Preachers. The growing of plants for special displays and the design and installation of most special exhibits is supervised by the Garden's Floriculturist, Paul Kohl.

MAINTENANCE

Engineering

Under the supervision of Engineer Kenneth Smith and Assistant Engineer James Hampton, the usual good maintenance and repair work on the heating plant and equipment was done. Installation work on boilers in the Museum, Shaw House, Administration Building and Experimental Greenhouse was completed, electric outlets in Floral Display House added, the orchid lab prepared, fans in greenhouses added, and the Curiosity House and Bromeliad House completely overhauled.

Grounds

The effectiveness of the Grounds Maintenance program, under the direction of Grounds Superintendent Louis Brenner, was demonstrated by their good condition throughout the season despite the only minor increase in labor. Change in grounds management technique, together with a revised system of labor deployment, have enabled effective and economic maintenance.

The winter months, early spring and late fall of the year were again devoted to removal of trees considered to be of little botanical value, in poor health or crowding more valuable specimens. Some were removed to provide better lighting of conservatories.

During sub-zero weather, rainy and snowy days, the Grounds Crew did maintenance work in the Experimental Greenhouse, Shaw Residence, Museum Building and in the Plant Conservatories and Growing Greenhouses.

Lawn areas are continuing to improve and many lawns, as in the knolls, were remarkably fine throughout the

Photo courtesy *Post-Dispatch.*

Janet and Sylvia Peck, daughters of Mr. and Mrs. Kenneth Peck, among the daffodils at the spring daffodil show.

year. A continued program of fertilizing, weed spraying, mowing and seeding will provide similarly excellent lawns throughout the Garden.

The Rose Garden flourished in the rather cool summer of 1958 and the abundance of blooms attracted many visitors. Much of the beauty was the direct result of help from a group of volunteers, under the direction of Miss Betty Lou Custer. They carefully removed old flowers and kept a succession of bloom in the Garden. Insects and fungal disease, especially Blackspot, were effectively controlled with the use of high pressure (600 lbs. per sq. in.) fog to apply fungicides. In this manner complete coverage, even on outlying borders, is quickly and efficiently obtained. Over 1000 gallons of spray material were applied to keep the Rose Garden in fine flowering condition. Heavy mulching of beds with wood chips and pecan shells greatly reduced maintenance problems and so preserved natural soil moisture that it was unnecessary to irrigate at any time during the growing season.

The increase in special social and educational activities at the Garden have made ever increasing demands on the Grounds Maintenance Crew, who have the task of moving and setting up properties necessary for such functions. Improved technique in management of the grounds, particularly extensive use of deep mulches, and of herbicides, the redesign of plantings to permit more efficient use of machinery, and effective deployment of labor have made it possible to help with such social and educational activities without overloading the work schedule of the Grounds Crew. The appearance of the grounds continues to improve.

INFORMATION CENTER

Mr. George Pring, Superintendent, and Miss Isabella Powell, Friends of the Garden secretary, maintained our information Center at the Main Gate, Miss Powell answering questions, selling books and pamphlets which tell about plants, and doing all the secretarial work connected with the Friends of the Garden. Mr. Pring answered numerous requests for expert information, appeared on television and radio programs and gave a number of lectures. He visited Longwood Gardens as a consultant for their new waterlily pools. Many new books and pamphlets are now available and the number of people who come to the Information Center for special publications on plants is increasing.

ATTENDANCE

The number of visitors to the Garden continued to increase. The turnstiles at the Main Gate recorded 240,960 visitors, 23,521 more than last year, and in addition an estimated 9,640 used the Cleveland Avenue gate or entered through the Alfred Avenue service gate. Turnstile figures for the past four years are:

1955	156,297	1957	217,419
1956	198,472	1958	240,960

SHAW HOUSE

Each weekend members of the Eighth District of the Federated Women's Clubs of Missouri served as hostesses, greeting visitors at the Shaw House and helping to create an air of hospitality. During the week, except for the months of December, January and February, Mrs. Walter Millan and Mrs. Will Wagner were hostesses.

Photo courtesy *Globe-Democrat.*

1958 Veiled Prophet Queen, Carolyn Lee Neidringhous, daughter of Mr. and Mrs. Lee I. Neidringhaus, with bouquet of Orchids presented by the Garden. The Queen and her two special maids, Miss Jeanne Behrens and Miss Mary Stephens Jones, held a special audience for children in the parlors of the Shaw House, Saturday, October 11.

ARBORETUM

Superintendent of the Arboretum, Frank Steinberg, has continued, by virtue of his intelligent planning, efficient use of equipment, and old-fashioned hard work, to keep the Arboretum in excellent condition and reduce expenditures. The area about the Pinetum Lake has never looked so attractive and the circular drive through this area is open to cars daily. The longer drive past the dogwoods, redbuds, and many drifts of naturalized daffodils to the trail house and wildflower trails was open to cars for the six weeks in April and May when the flowers were at their best.

Mowing the large grass areas, pruning trees and removing dead trees, and maintaining the roads takes most of the time of Superintendent Steinberg and his assistant, Emil Diener. Most of the farmland on the south bank of the Meramec River is under Soil Bank and Soil Conservation plans which yield a cash return, improve the land, and require very little labor.

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A PICTURE OF THE GARDEN

Mr. Frank McCready has spent many days during several years in the creation of a colored film of the Garden. His projections of this film to groups in St. Louis and neighboring cities has helped to spread the knowledge of the many beautiful and instructive aspects of the Garden.

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NATIONAL COUNCIL OF STATE GARDEN CLUBS HEADQUARTERS

In December the offices of the National Council Headquarters opened with Mrs. Earl Hath as Executive Secretary. With about 400,000 members in nearly 13,000 clubs, this is the largest gardening organization. Their headquarters here establishes St. Louis as the gardening center of North America. Some work remains to be done on the building. The formal dedication will be held May 10th.

* * *

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Frits W. Went	Director
Hugh C. Cutler	Executive Director
Edgar Anderson	Curator of Useful Plants
Henry N. Andrews	Paleobotanist
Evelyn Barbour	Research Assistant and Editor of BULLETIN
Clarence Barbre	Instructor
Louis G. Brenner	Arborist and Grounds Superintendent
Ladislaus Cutak	Horticulturist and Greenhouse Superintendent
Josephine L. Davies	Assistant in Education
Carroll W. Dodge	Mycologist
Robert Dressler	Taxonomist and Editor of ANNALS
John D. Dwyer	Research Associate
E. L. Evinger	Horticulturist in charge of Experimental Greenhouse
Robert J. Gillespie	In charge of Orchids
Oscar E. Glaessner	Controller
Paul A. Kohl	Floriculturist
Emmet J. Layton	Landscape Architect
Viktor Muehlenbachs	Research Associate
Norton H. Nickerson	Morphologist
Kenneth O. Peck	In charge of Visitors' Activities
Isabella T. Powell	Friends of the Garden Secretary
George H. Pring	Superintendent
Kenneth A. Smith	Engineer
Julian A. Steyermark	Research Associate
Frank Steinberg	Superintendent of the Arboretum, Gray Summit
George B. Van Schaack	Librarian and Curator of Grasses
Trifon von Schrenk	Associate Curator of the Museum
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Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., adjacent to State Highways 50 and 66. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.

MISSOURI BOTANICAL GARDEN

Bulletin

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April, 1959
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CONTENTS

Oh Happy Day — Her Orchid Bloomed

Old-Fashioned Cannas For St. Louis

Plumbago and Ivy — A Good Combination For Late Summer Gardens in St. Louis

Educational Programs For Children at the Missouri Botanical Garden

Book Review

Plants in Relation to Climate

COVER: Mollis hybrid azaleas.

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Missouri Botanical Garden Bulletin

Vol. XLVII No. 3 APRIL, 1959

OH HAPPY DAY — HER ORCHID BLOOMED

CLARISSA START

I'VE been attending spring luncheons lately and admiring the table decorations. The Highland (Ill.) Women's Club made place mats and table borders out of these columns, which they'd collected for months, proving that there are things you can do with old newspapers even if you have a garbage disposal. Foreign flags, dolls, books have been used by other clubs. But everywhere forsythia has been forced into bloom.

Now I've never had much luck forcing forsythia but one of the clubwomen told me it was simple. Keep the forsythia in warm water in a dark corner of the basement, the darker the better, until it starts to open. Then bring it out into the light. She doesn't know how to time it so it opens on the right day. Hers opened a week early and she had to start all over.

My experience with our orchid plant was just the reverse, but I was so surprised and delighted to see that orchid bloom, I didn't care when it put on its show.

The orchid joined our plant collection—an undistinguished group of philodendron, mothers-in-law tongues, a few unsprouted begonia tubers and half a dozen will-they-or-won't-they-make-it geraniums—when I became a Friend of the Garden. I had always been a friend of the garden, Missouri Botanical (Shaw's) Garden, that is, but I felt even friendlier when I learned that in return for becoming an official contributing Friend I would receive an orchid plant. [From a limited surplus, now exhausted. *Ed.*]

It was easily the coldest day of winter when I called at the greenhouse to present my coupon. The girl who led me to the gift plants was apologetic. Most of them had been given away and she wasn't sure there was one with a bud.

"Never mind," I said. "I'll consider myself lucky if this lives. I won't expect it to bloom."

Shielding the orchid plant with newspaper (another good use for old ones) I carried it home and read the mimeographed instructions. They did not say you had to have a greenhouse, which I had always assumed, or that they must grow under fluorescent light, as some of the experts are trying. They merely stipulated that you put the orchid in a sunny window, keep the pot on moist gravel for humidity, and water it by soaking once a week.

I scooped some rocks out of the driveway and put them in an old casserole as a base for the flower pot. Once a week I have been placing the flower pot in the bathroom washstand in water to the rim of the pot. Either it absorbs water quickly or we have a leaky stopper but the water soon disappears.

Two weeks ago I noticed a faint tinge of purple at the edge of what I had assumed was a new leaf. It was a bud about to open. I began to hover over it, coax it, give it the fluorescent light treatment. When it looked as if the flower were just about to unfurl, we called our friends in for an impromptu party to celebrate Hawaii's statehood. We planned on fresh pineapple and orchids for decorations.

But the bud remained tightly, stubbornly sheathed, even in the middle of the party table. The next day, surrounded by crumpled napkins and stacks of dishes, it opened—or rather, they opened, two gorgeous flamboyantly purple orchids. Admired only by the family, they've continued to bloom all week as proudly as if they were in the V. P. Queen's bouquet. It really doesn't matter that the timing was slightly off. I still feel like Luther Burbank.

—Reprinted from the *Post Dispatch,*
March 24, 1959

OLD-FASHIONED CANNAS FOR ST. LOUIS

A century ago old-fashioned Cannas or "Indian Shot" were one of the most popular summer plants for St. Louis. They take kindly to sun and heat, to heavy clay soils and city conditions; from June to October they make themselves very much at home here. Fifty years ago, handsome large-flowered varieties became fashionable and the tough tall-growing varieties almost disappeared from the city.

In the last decade they have been making a real comeback; this note is designed to call attention to the ease with which they can be managed and the various ways in which they can be used in the modern garden. If there is any tropical or sub-tropical plant which is easier to grow in St. Louis I do not know of it. The fleshy rhizomes are set out just barely covered with soil as soon as the weather gets really warm. During spells of drought the cannas will do better with frequent waterings but they can go for long periods with no water at all and still show few bad effects. In good soil they shoot up rapidly and by September will be ten feet or more tall; but if one does not want them that height they are easily cut back to whatever size desired and the prunings make attractive flower arrangements either alone or in combination with other material. The flowers are small, of a deep coral red, and quite attractive, particularly when one looks out at them from inside the house. They, too, are most appropriate for modern flower arrangements because of their strange color and interesting form. Unlike the large-flowered varieties the petals are tough and are seldom damaged by wind or sun or insects.

In Victorian times cannas were usually planted in little circular beds set off by themselves. For a modern garden they can be planted in large blocks as part of the design or they can be used most effectively here and there to fill in among other things, to shade more delicate plants, or to grow in hot dry corners next to a wall where nothing else will survive. Though they prefer sunshine they will put up effectively with a good deal of shade.

The only necessary precaution is to dig the roots before real winter has set in. The rhizomes are not injured even after frost has cut down the foliage but a real freeze will kill them outright. No precautions are necessary in storing them. They can be dug with wet clay soil adhering to them or taken up in a drier autumn with nothing on the roots. In either case they will come through the winter in a warm dry basement with no special treatment of any sort. They can be dumped into a basket any which way and, if they are kept warm and dry, will need no further attention until they are set out.

One of the most interesting places to grow these tall cannas is directly in front of a kitchen window where they may be watched from day to day. After they get up tall enough to be seen from the kitchen the new leaves are beautiful and fascinating to watch. They first show above the leaves below them, like tightly coiled pencils. In hot humid weather they develop so rapidly that one can almost watch them grow. The edges of the leaves and their dark rich shadings as they mature are almost as beautiful as the blossoms themselves. —EDGAR ANDERSON

PLUMBAGO AND IVY

A GOOD COMBINATION FOR LATE SUMMER GARDENS IN ST. LOUIS

A bright blue perennial ground cover known in the trade as *Plumbago Larpentae* has long been recognized as one of the most reliable low perennials for late summer gardens in St. Louis. The proper botanical name for this charming plant is *Ceratostigma plumbaginoides*; but few, indeed, are those gardeners who have any idea what plant you are talking about if you use this set of mouth-filling vocables. If ever a nice little plant deserves a good common name, it does; "Plumbago" does not make a good one since there are tender subtropical plants already widely known by that name.

By a happy accident Ceratostigma was tried in combination with Bulgarian Ivies in the Missouri Botanical Garden and the results are both practical and pleasing. Shortly after the collection of Balkan Ivies was received at the Garden, a spot along the east wall was selected for a critical test of their hardiness to cold and to drought. It was felt that if they would grow there, they would be really practical in St. Louis and they were set out between a bed of Ceratostigma and the high limestone wall.

In the 20 years since this test was started, the ivies have not only climbed the wall; they have overrun the entire flower bed, the grass strip in front of it and now they border directly on the walk itself. The shrubs which used to be in this planting have gradually been removed and the Ceratostigma, with no other encouragement, now grows happily in under the ivy. In the spring the ivy comes rapidly into leaf and the Ceratostigma is scarcely visible. As summer advances, the ivy slows down its growth and the Ceratostigma pokes through the ivy leaves and grows up above them, bursting into vigorous bloom in mid-summer and continuing in flower for some weeks. Frequently the leaves turn red in late autumn providing an interesting contrast at the very end of the season. The brilliant blue of the Ceratostigma makes a beautiful display above the dark green leaves of the ivy and the combination can be maintained in an attractive condition for very few man hours per year. —EDGAR ANDERSON

EDUCATIONAL PROGRAMS FOR CHILDREN AT THE MISSOURI BOTANICAL GARDEN

KENNETH O. PECK

FOR the first time in the history of the Missouri Botanical Garden, there is an organized series of comprehensive educational programs for children of a wide age range. The sustained response to the various new activities has been gratifying and, in accordance with Henry Shaw's desire to acquaint the general public with the Plant Kingdom, a great number of children have been exposed to botany and horticulture. The following account is a description in some detail as to the kinds of programs offered and the mechanics of each.

TOURS

Guided and self-guided tours are provided, but no tours are regularly scheduled. Guided tours are scheduled by appointment and include general tours of the Garden, the Tree Trail, and a tour entitled, "Introduction to Botany." Teachers or group leaders interested in bringing a group for the Tree Trail are given or sent a guide booklet describing the trail and providing general information about the 40 trees found on it. Each member of a group receives a free Tree Trail Guide Sheet showing leaf outlines and tree silhouettes of trees on the trail in addition to a map of the trail. All trail trees are individually numbered and labeled. Since its inception in September of 1957, the Tree Trail has been walked in whole or in part by an estimated 12,000 to 15,000 children and adults. A group desiring a guide is directed through the first half of the trail; although the trail may be easily followed unguided. The "Introduction to Botany" tour, primarily confined to the conservatories, requires a guide who serves to point out such botanical curiosities as insectivorous plants, epiphytes, orchids, and peculiar plant growth habits.

In addition to the tours guided by Garden Staff members, a great number of tours arranged for special groups of both children and adults are directed through the Garden by a staff of volunteer guides headed by Mrs. Paul H. Britt. These volunteers who have been trained at the Garden and who participate in garden activities, are also available by appointment.

SUMMER NATURE CLASSES

During the summer of 1958, two five week sessions of nature classes were offered in the Pitzman Nature Program at the Garden. The classes covered trees, birds, animals and insect pests, and plants in general. In the "Trailfinders" class, children made leaf prints of 30 to 50 trees and pressed fresh leaves. Some magnificent leaf and leaf-print notebooks were made and entered in competition in the 1958 Fall Harvest Show. The class in "Birds" was instructed by members of the St. Louis Audubon Society. It covered habits of migration nesting, and feeding, and offered bird walks and films. In "Man's Enemies," the children looked at animal and insect pests. They made their own insect collecting nets from coat hangers and cheesecloth and mounted their insects in cigar boxes. "Plants and Man" was a course which attempted to introduce children to the Plant Kingdom through the study of flower structure, seed dispersal, plant anatomy, methods of propagating plants from seeds and cuttings, and the life cycles of mosses and ferns.

These summer classes met twice a week and were attended by close to 300 children. Nature films were shown in the event of inclement weather; but classes were otherwise held out-of-doors. The classes were instructed by three Garden Staff members. Each child was required to register for the course or courses in which he was interested. Certificates were awarded to children who attended at lease 60% of the meetings of any one class.

SATURDAY ACTIVITIES

The most recent program for children is the series of Saturday morning classes. The instructors are Josephine Davies, and the writer. Insofar as it is possible, the individual morning activities are planned so that one activity is not a prerequisite for another. This enables anyone attending for the first time to fit into the schedule of a single morning's activity. Some unavoidable instances of where this is not entirely possible is in the case of a class covering propagation of plants from cuttings or sowing seeds for a garden —each an activity requiring a child to return to pot rooted cuttings or transplant seedlings.

The schedule of activities is printed on 4 × 5 cards which are available through the garden. Each activity is attractively, and some intriguingly, titled. Such activities as tours, propagation of plants from cuttings and seeds, making Christmas wreaths and miniature gardens, and hearing demonstrated lectures in botany and horticulture have attracted many children. Nature films are shown every six weeks and, as far as possible, pertain to a particular morning's activity. The average Saturday morning's attendance has been 70 children. As many as 15 first-comers have attended on a single morning, and since the first class on December 13, 1958, more than 250 children have attended the classes. There is no registration but attendance records are kept on each person for the purpose of issuing certificates.

There is no charge for any of the programs described above and no limit is placed on the number of children who may attend. Two age groups, 7 to 10, and 11 to 18, are designated for all programs except tours. Attendance is kept by making a name tag for each person attending an activity. The tags are punched and hung on a pegged board. When a child comes for a class, he removes his name tag from the board and turns it in to the instructor.

The emphasis in most classes is placed on plants and all plant material is provided by the Garden. For classes in which something technical, such as seed structure or fern and moss life cycles, is studied, an illustrated, one-page, mimeographed information sheet is given to each child. Since very little is required of these children with respect to learning something, they are told that they need not remember *anything*, but are asked to understand *one time* what they are being told. After this, they relax and are more often than not attentive. The best follow-up to such a procedure is giving the class something to do relative to what they have been told, and, if possible, giving them something to take home.

Three major difficulties are encountered in planning and executing these programs. In the case of the Saturday classes, there is the problem of knowing how many to plan for. This has been solved only by keeping an attendance record and noticing what kind of activity is most popular. For example, the attendance for movies is usually between 50 and 60, while the attendance for making miniature gardens was 85, The second problem is that of discipline, or, more aptly, a substitute for discipline. This substitute has proved to be some sort of physical activity although this may not always work. Rowdy children are asked to leave the class. Sometimes, however, a group will sit and listen to a lecture on mosses or ferns for an hour and be most attentive. The third problem is finding a large variety of interesting projects in which large numbers of children can participate. It is known that some projects will be popular, but the attractiveness of others has to be tried.

It is not the purpose of these programs to make botanists and horticulturists out of every child who attends the classes, although a few may later pursue the study of plants. In a time when Buck Rogers and Flash Gordon are rapidly becoming non-fiction, science for its own sake is given great emphasis. Much of this is necessary, but care must be taken to insure the preservation of a person's individuality along with his scientific accomplishments. The purposes of the programs described above are to provide diversion to children as well as a scientific approach, with a personal touch, to the study of the Plant Kingdom.

The Pitzman Nature Program will be offered again this summer with the following schedule.

PITZMAN NATURE PROGRAM
SUMMER 1959

First Session: Each Tuesday and Thursday from June 16 through July 16.

Second Session: Each Tuesday and

Thursday from July 21 through August 20.

Classes will be held out-of-doors. In case of rain, films will be shown in the Museum Building.

Children attending classes in both the morning and the afternoon may bring their lunches.

SCHEDULE OF CLASSES

	Age Group	
Time	7–10	11–18
10 a.m.	Birds	Trailfinders
11 a.m.	Trailfinders	Birds
1 p.m.	Plants and Man	Man's Enemies
2 p.m.	Man's Enemies	Plants and Man

Instructors:

(Birds): June 16th to July 16, Mr. Earl Hath, President of the St. Louis Audubon Society, Mrs. Earl Hath, and Jeane Stern, of the St. Louis Audubon Society.

July 21 to August 20, Mr. Stuart O'Byrne, Mrs. Stuart O'Byrne, and Helen Bowman, all of the St. Louis Audubon Society.

(Trailfinders, Man's Enemies, and *Plants and Man):* Mary Beth Andrews, Josephine Davies and Kenneth Peck, all members of the Garden staff.

SATURDAY ACTIVITIES PROGRAM

May 2	Hunting for Hidden Flowers
May 9	Plants from Prehistoric Times
May 16	Color Sound Movies
May 23	The Life Secret of a Plant
May 30	Plants with Wet Feet
June 6	What Is a Tree?
June 13	Exploring the Underworld
June 20	The Queen of Flowers
June 27	Color Sound Movies
July 4	A Morning in the Garden
July 11	Shades of the Night
July 18	Flowers for Breakfast
July 25	Life in the Desert
Aug. 1	Peas in a Pod
Aug. 8	The New Generation
Aug. 15	Color Sound Movies
Aug. 22	Dangerous Plants
Aug. 29	Table-Top Greenhouses
Sept. 5	Gardening through the Ages
Sept. 12	Plants for the House
Sept. 19	The Hundred-in-one Flowers
Sept. 26	Color Sound Movies

Time: 10:00 to 11:30 A.M., every Saturday.

Age Groups: 7 to 10, 11 to 18.

Admission: Free. No registration. One or all programs may be attended.

Instructors: Josephine Davies and Kenneth Peck.

For Information: Phone PR 6-5567.

BOOK REVIEW

Colombian Orchids. By Mariano Ospina Hernandez. Publicaciones Technicas Ltda. Bogotá, D. E., Colombia. 1958. 305 pp., 10 pp. color illustrations. Price $7.25. (Text in both English and Spanish).

One cannot read this book without feeling the tremendous contributions which Colombian orchids have made toward the development of the many beautiful hybrids which are to be found in our modern orchid collections. All of the horticulturally important species in Colombia, as well as most of its little known and seldom cultivated botanical orchids, are described and illustrated. While not a complete taxonomic treatment of the orchids of Colombia, this book is, nevertheless, well written in a style that is simple and easy to understand. The last 45 pages are devoted to orchid culture and it is interesting to one living in and growing plants in a temperate climate, to read of the cultural problems encountered by plant growers in a tropical region where altitude and other factors create innumerable climates in one small geographical area.

The line-drawings which accompany the text are excellent, but they would be more useful if they had English sub-titles. On the whole the book should make an excellent addition to any orchid fancier's library.

—ROBERT J. GILLESPIE

PLANTS IN RELATION TO CLIMATE

THERE are at least a dozen factors which all have to be right if you want to grow a plant successfully in your garden. There are problems of soil, of watering, of feeding, of disease and pest control, of shading and of exposure, but one usually overlooked is the problem of climate. Each plant has its own special needs for temperature; some, such as peas and sweetpeas, and nasturtiums, will only grow under cool conditions. Others, such as corn and soybeans, grow best when the temperatures are high. Again, others need a period of cold weather between summers. Most deciduous trees behave that way: a peach or pear tree, for instance, will not leaf out in spring unless it has gone through a cold period during winter. These plants even won't flower unless they are subjected to a cold winter a year and a half beforehand.

It is interesting that for many plants the temperature during night is critical. When, for instance, we try to grow tomatoes they will produce fruits only when the night temperatures are between 60° and 68°. This means that in spring and in autumn the night temperatures are too low for tomatoes to set fruit. In hot summers, on the other hand, the night temperatures may be too high and again the tomato plants do not set fruit. In any climate where the night temperatures are regularly between 60° and 68° tomato production is good, no matter whether the days are cool or hot. These facts explain why in many years we have difficulties in tomato production in our gardens around St. Louis.

Potatoes are able to grow over a wide range of temperatures, but tubers are formed only when the nights are between 50° and 60°; therefore, we cannot grow successfully tomatoes and potatoes at the same time. For potato production, a climate with real cool summers is ideal, such as Maine or Idaho.

To investigate the likes and dislikes of plants we must have greenhouses in which we can control the temperatures. It is hoped that in the future we will have a set of such greenhouses at the Missouri Botanical Garden so that we will be able to find out the climatic preferences of many of our garden plants.

—F. W. WENT

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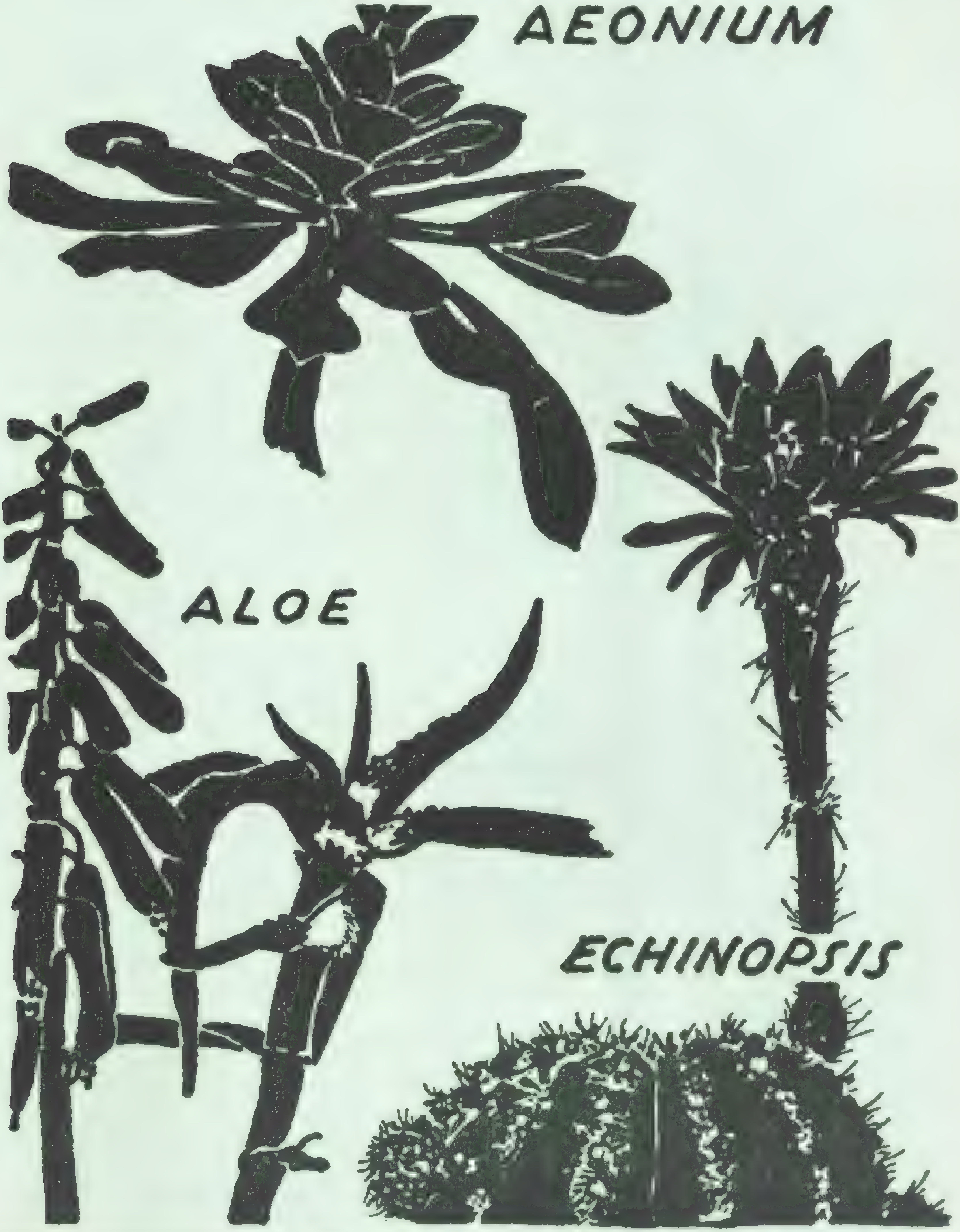
Succulents


AEONIUM
ALOE
ECHINOPSIS

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Succulents

LADISLAUS CUTAK

When the term "succulent" is used it immediately brings to mind something that is juicy, and that is exactly what the word means. It is derived from the Latin *succulentus*, meaning juicy, pulpy, and thus is an apt term to describe plants with juicy stems, branches, or leaves. However, not all juicy or pulpy plants are considered succulents. For instance, Begonias possess fleshy stems and leaves but usually they require a great deal of moisture to keep them alive. A true succulent is a plant which has fleshy leaves and stems of greater thickness than the average serving as storage organs for water, thus enabling the plant to withstand prolonged periods of drought.

Succulent plants are frequently associated with deserts, as the place of their abode. Webster defines a *desert* as an arid region lacking moisture to support vegetation. "A desert is not only relatively uninhabitable, but commonly uninhabitable, through barrenness." There are many vast regions on this globe of ours which answer to this description. Familiar examples are the Sahara in Africa and the Gobi in Asia, where hardly any vegetation of any kind exists. However, there is still another type of desert, or better, semi-desert, which is inhabited by miscellaneous plant life. The deserts in our own Southwest and in Mexico, the Canary Islands and South Africa are of this type. These semi-deserts support a host of annuals, low thornbushes and many plants of succulent habit. The annuals are short-lived and often complete their life cycle (seed to plant to seed) within a year—many doing so between rains which are infrequent. The thorny shrubs, such as Mesquite and Retama, exist only because they send their roots deep into the soil, often 15 feet or more, where moisture always is present. The remainder of the plants are able to survive due to their ability to store moisture in their stems, their leaves or in underground tubers. These plants, as a group, are called succulents.

In addition to deserts or semi-deserts there are many dry regions such as the Alps, the Himalayas and the Andes, as well as parts of the Arctic, and many other regions, which support succulent plants, but where the drought conditions are caused by rarefied atmosphere, scarcity of soil, rapid drainage of water, cold, and other factors.

Succulents are not limited, however, to the dry regions of the world. Many succulents are native to Missouri, for example, and the sections of the world that are not considered dry. In many areas the micro habitat of succulent plants will be hot and dry, such as would be found on glades or rocky hillsides throughout much of the growing season.

However, the greatest concentration of bizarre succulents is in the deserts, for their peculiar ability to store great quantities of water is of course most valuable there. It is these bizarre plants that are most attractive to collectors and which are responsible for such organizations as the Cactus and Succulent Societies.

Succulents on the whole are not deep rooted. Many possess a root system which spreads greatly just under the surface of the soil or in tangled masses in fissures of rocks. They are able to absorb moisture fast when it becomes available and to retain it for long periods in their plump or succulent bodies. The degree of succulency is what makes some of these plants so bizarre and grotesque, particularly the cacti and spurges. Water is held in the extra cells of the leaves and stems by various protective devices to hold down transpiration which would be high in a hot and dry atmosphere. A thickened organ has less surface exposed to the air than a thin, flattened one of the same bulk. Thus the plump forms typefied in succulents reduce surface and lessen water loss by evaporation. The ribbed, fluted, or tubercled stems of cacti, for instance, allow for expansion and contraction during periods of water abundance and of drought. Thick waxy skins, best exemplified in cacti, cover most of the succulents. In others, such as the Crassulaceae, the thick leaves are covered with a bluish waxy powder as in *Dudleya pulverulenta* and *Echeveria gibbiflora,* and with an abundance of hairs, felt or wool, as in *Kalanchoe tomentosa, Crassula tecta* and *Echeveria pulvinata.*

In a typical desert where the sun beats down unmercifully throughout the year, a preponderance of succulents can be found. The buttes and high mountains in such regions also support a great number of succulents and it is often mystifying how so many monstrous growths can thrive on the steep and arid slopes which are buffeted by strong winds. Farther up the slopes the succulents become stunted in the rarefied air and become more or less cushion-like or carpeting in habit, true of many Sedums and Sempervivums.

In the United States there are many semi-arid regions; those best known are in Texas, New Mexico, Arizona, Colorado, Utah and California—the Great Southwest. The characteristic plant of the Great Southwest is the *cactus.* It is, in fact, the dominant succulent in American deserts, often attaining tremendous proportions. Certain species of the *Cereus* group grow to fifty feet; and, with their innumerable water-filled branches, they weigh several tons. The greatest concentration of cacti is found in Mexico where more than 900 species exist. Giant cacti are also found in Peru, Ecuador, Bolivia, Brazil, Argentina and Chile. Companions of the cacti in American deserts are the Yuccas and Agaves, which also attain great size. Although they are more aptly classed as *xerophytes* rather than succulents, they generally are included in the latter category. A xerophyte is a plant which exists under conditions of great dryness. The means by which it is able to do so may or may not be succulency, so not all xerophytes are succulents.

South Africa is probably home to

more different kinds of succulents than is any other region on this globe. In the very hot dry South African deserts where the rocky or sandy soil is extremely poor only plants capable of adapting themselves to such unfavorable conditions can survive and thrive. Yet here grow some of the daintiest succulents known, many of them so tiny that they are easily overlooked. Here also grow the Euphorbias, or Spurges, which greatly resemble the cacti but which are related to the Poinsettia. Some of these desert plants become enormously tall and bulky while others grow in cushion-like or mound-like shapes. The ground is often covered with shrubby Mesembryanthemums or Fig-Marigolds with colorful daisy-like blossoms of every imaginable hue. Stapeliads may be found growing in the shade of low scrub. The Cape Region is conspicuous with Euphorbias and Aloes, the latter frequently growing in huge clumps which in the flowering season become decorated with brilliant spikes of tubular flowers.

The Canary Islands are noted for many beautiful succulents, particularly the remarkable Aeoniums belonging to the Crassulaceae. Some of the species have stout woody stems surmounted by large rosettes of leaves. These plants do exceptionally well in California and many gardens there feature them. Some of the rosettes are as big as pie plates and flat as table tops.

CULTURE AND CARE

Succulents lend themselves admirably as house plants. Of course they will do better if housed in a greenhouse because conditions therein are more ideal—due to better light, freer flow of air, more stable temperature, and other factors. In the greenhouse shading is not necessary although a light shade is preferable in the summer months. It is to be remembered that a good number of the *leaf succulents* do get partial shade since, in nature, they grow under thorny scrub or in the protection of rocks. Succulents exhibiting the thorniest armament, such as the cacti, *Ferocactus* and *Echinocactus,* and the spurges, *Euphorbia,* usually indicate the nature of their habitat—the hottest, driest and most sun-parched portion of the desert.

There are a number of shading compounds on the market which can be sprayed on the glass roof of a greenhouse. Some are easily prepared with water and form an even coating on the glass. Linseed oil can be added to make a permanent shade.

CONTAINERS:

Clay pots are preferred by the hobbyist for succulent plants. Since clay pots are porous, water as well as air can pass through them. On the other hand, ceramic pottery, although attractive, does not permit water and air to move through the soil and if these containers are used by the grower, care must be exercised not to overwater as that will cause "sour" soil to form. Glazed pottery does serve a decorative purpose and the use of it is not discouraged; although it is efficient as a temporary container at best, unless used as an outside pot with a loosely fitting clay pot within.

Succulents, as a rule, do much better in a size-smaller pot than would be used for an ordinary house plant. The more vigorously growing plants will require transplantings to successively larger pots. The slow growing kinds can remain in the same container indefinitely, although transplanting or at least renewing of soil would be beneficial about every third year. One should study his plants' needs and conclude the type and size container each plant will require. Aloes and Agaves are examples of strong-growing plants with an abundance of roots. On the other hand, Gasterias, Haworthias, Stapelias and stemless Mesembs require very shallow pans. Most succulents will thrive in standard clay pots for a number of years.

POTTING SOIL:

Succulents will thrive in a more or less porous soil. Good old compost, well-rotted leafmold and sand are the ingredients necessary and, when mixed in equal amounts, provide a good medium for most succulents. It is the easiest to make or obtain. A heavy soil is usually detrimental to the root system as it becomes waterlogged more easily and causes the roots to rot. Many cacti and some of the other succulents welcome the addition of lime in the form of old rubble from buildings. Manure can also be added to the mixture to provide nourishment. Fertilizers with high content of nitrogen should be avoided. Do not use the real fine sand such as is sold in pet shops for aquariums because it packs too much. Clean, coarse river sand is ideal. When potting up large plants such as cacti, Euphorbias, Aloes and Agaves use quite coarse soil with the addition of limestone chat, gravel or broken charcoal to it. This will provide for quick drainage. Fast and complete drainage is the key to successful growing of succulents.

TRANSPLANTING:

The use of new pots is always preferable, but old pots can be used if well washed inside and outside, and then dried. Place a few pieces of broken pot in the bottom of the container to aid drainage. In transplanting, should the roots have beome pot-bound, it is advisable to break off the pot with a sharp blow, instead of risking damage to the plant in trying to take it out. Try to take out the plant with its ball of earth, carefully removing the pieces of broken pot at the bottom so as not to injure the roots. Replant just as deep down as it was in its previous container and sift fresh soil all around the ball of roots, firming it with the thumb or a wooden tamper. If there was no ball of earth and the roots were quite loose, hold the plant in the pot with one hand and with the other sift soil between the roots, pressing down the earth all around the pot. When transplanting it is safer to use dry soil beneath and around the plant so that if any of the roots were damaged during the operation some time will be allowed for the wounded tissues to dry and heal. Withhold water for a day or two or just keep the soil very moderately moist, in order to promote the formation of new roots. After new growth has started more water can be given freely.

WATERING:

Since smaller pots of succulents usually dry out considerably even in the greenhouse during the summer months, daily watering will be necessary. Pots on the windowsill will have to be watered daily during the growing season also; but the larger the pot the fewer waterings will be needed if the plants are well-soaked each time they are watered. If the collection is not too large, place the plants in a bathtub and let the water soak into the soil from the bottom. Such watering will usually suffice for a week or ten days. During the dormant or winter season, most succulents, especially the cacti, will require less water; and it is also recommended that the plants be kept in a cool place where the temperatures do not go below 45 degrees F. or above 55 degrees F. How to water plants correctly is the trickiest part of gardening. Examine the plants daily; if the soil is dry to the touch, water is needed; if the soil is damp, no water is needed.

FERTILIZING:

Most succulents make little demand on the soil for food and it is better to avoid fertilizers since they are not required if the soil is good, and their use will cause the plants to make abnormal growth, become distorted, and easy victims to rot. Nitrogenous fertilizers are *generally* not recommended but those with larger quantities of superphosphates may be used. During the growing season, seedling succulents usually respond to highly concentrated fertilizers like RA-PID-GRO (23-21-17), FOLIUM (20-20-20) and others, even though the nitrogen content in these is rather high. I have been using these fertilizers periodically on cacti, Crassulas, Haworthias and on almost all succulents with good success. The main thing is not to overdo it.

SUCCULENTS IN THE GARDEN

If at all possible all succulents should be placed outdoors during the summer in temperate climes. There are many ways to exhibit them in rock gardens, borders, or beds. They can be plunged in the soil with their pots or arranged in tiers on mounds, or stands or placed on improvised fence shelves, etc.

Good drainage, as mentioned before, is the secret of successful plant culture, especially in regions where the rainfall is normally too high in comparison with the natural home of the plants. A natural slope or an artificial mound, receiving a sufficient amount of sunlight, is an ideal location for hardy succulents. It is surprising how many hardy succulents there are. One can almost make a garden of them alone as a permanent adjunct to a yard, perhaps utilizing some of the most showy tropical kinds with them in the summer. When a garden is planted beside a building there should be some means of protection from the run-off of rain from the roof. The cacti, in particular, contain a surprising amount of water within their bodies and excessive moisture only tends to induce rot.

The type of soil is also of utmost importance and should consist of rather coarse material composed of gravel, sand, garden soil (not clay), and well decomposed leafmold. To this can be added a little lime in the form of broken bits of limestone, powdered shells, etc.

HARDY SUCCULENTS:

The Sempervivums, commonly known as Houseleeks, prefer the crevices of rocks and rock walls, which afford opportunities for them to scramble hither and thither and which permit them to cover rock depressions with their small, grey-green rosettes. Once these plants are established in well drained soil and a sunny location, it requires very little care to keep them growing. *Sempervivum tectorum* is the best known of the group—a sturdy dark-green rosette with leaves tipped with a tinge of red. The oddest member is perhaps S. *arachnoideum* which grows in dense masses of dainty rosettes often completely covered by filmy webs spun by the plant itself. All of the Sempervivums are rosette-forming plants, propagating themselves by means of young shoots which spring from the base of older rosettes. The Sedums are the most typical of the hardy succulents grown in rock gardens and there are so many varieties commonly cultivated that very little will be said about them here. *Sedum sarmentosum* with its yellow-green foliage makes a dense carpet in a relatively short time, and the showy S. *spectabile* is an excellent border plant. *Sedum ternatum* can withstand considerable shade since it prefers rocky woods in its native habitat. One of the most delightful annuals is S. *pulchellum* with white or purplish blossoms.

The Talinums are the least known of the Purslanes (Portulacaceae) among gardeners, yet when used in a rockery they are excessively colorful. The plants somewhat resemble certain Sedums and grow from thickened rootstocks each Spring, producing pink- to rose-colored ephemeral blossoms throughout the summer season. *Talinum calycinum* is a lovely gem, native to the states west of the Mississippi. It has a long flowering period. *T. teretifolium* is an Eastern species almost identical with the preceding, although with smaller flowers, fruit, seed and leaves. The Talinums multiply rapidly and require a well-drained soil and a sunny location, since their flowers will open only in bright sunshine.

Yuccas are American plants but their popularity was known in Europe as early as 1675. The hardy Yuccas are low-growing in habit and have a cluster of gracefully curved to rigid narrow leaves shooting up from the ground. *Yucca filamentosa* is a very desirable species. At the Missouri Botanical Garden it is used effectively in corners of beds of annuals and perennials in the Linnaean garden. *Yucca glauca* is less frequently cultivated, yet it is highly ornamental with quite narrow leaves and large, waxy, greenish-white blossoms. It is quite common on the plains of midwestern United States. *Hesperaloe parviflora*, a yucca-like plant from western Texas, is hardy in the St. Louis climate. It bears a slender flower stalk surmounted with reddish tubular flowers.

Of the hardy cacti, the Opuntias or Prickly Pear Cacti are the most familiar; they are characterized by broad flat green oval pads, which are covered with more or less evenly-spaced depressions containing sharp needle-like spines and cushions of short bristles, called glochids. The flowers are large and usually yellow, though some have reddish centers. The pincushion cacti, and these include *Coryphantha vivipara, Pediocactus Simpsonii* and three or four species of *Neobesseya*, are all of the hardiest nature, surviving winters even in our northern States. The Hedgehog cacti, belonging to the Echinocereus group, are short, cylindrical stemmed plants and the hardiest among them are *Echinocereus viridiflorus, E. Baileyi, E. Reichenbachii* and *E. coccineus.*

Certain cacti, due to their symmetry, can be made attractive in beds of the formal type but this kind of garden is usually possible only on large estates or recreational grounds. Circular or rectangular beds form the most pleasing designs and these should be slightly elevated towards the middle in order to insure good drainage for the plants. The best plants suitable for a formal design are the tropical Mammillarias, Malacocarpi, Notocacti, Gymnocalyciums and Parodias, since most of them have small globular to short cylindric bodies covered with a variety of colorful spines. When an odd assortment of cacti is to be used, arrange the larger species on the crest of the mound, graduating with the smaller ones toward the edges.

A rock garden need not be given

An impressive cactus garden in St. Louis. (All the plants must be taken indoors for the winter. Photo by Ladislaus Cutak.

Cacti and Succulents can be used effectively with other tropical plants as in this Florida garden. Photo by Ladislaus Cutak.

over strictly to cacti for these plants harmonize beautifully with other succulents and equally well with many other rock-loving plants.

A permanent cactus rockery is almost an impossibility in the colder sections of our country except in the southern states, yet there are a number of fascinating species such as those already mentioned that will live through severe winters. Many others from high altitudes are available but it must be remembered that only among the tropical kinds will be found the most ornamental types both as to flowers and stem structures. A planting of tropical cacti is practical in the Midwest but the plants must be brought indoors for the winter.

In the warmer regions of California, Texas and Florida cactus gardens are very popular and a visit to these sections will disclose many pleasing effects created by the use of the plants in foundation plantings. The peculiar Spanish architecture forms a fitting background for bristling Opuntias, columnar and branched Cerei, grotesque Euphorbias and bushy Aloes.

SUCCULENTS AS HOUSE PLANTS

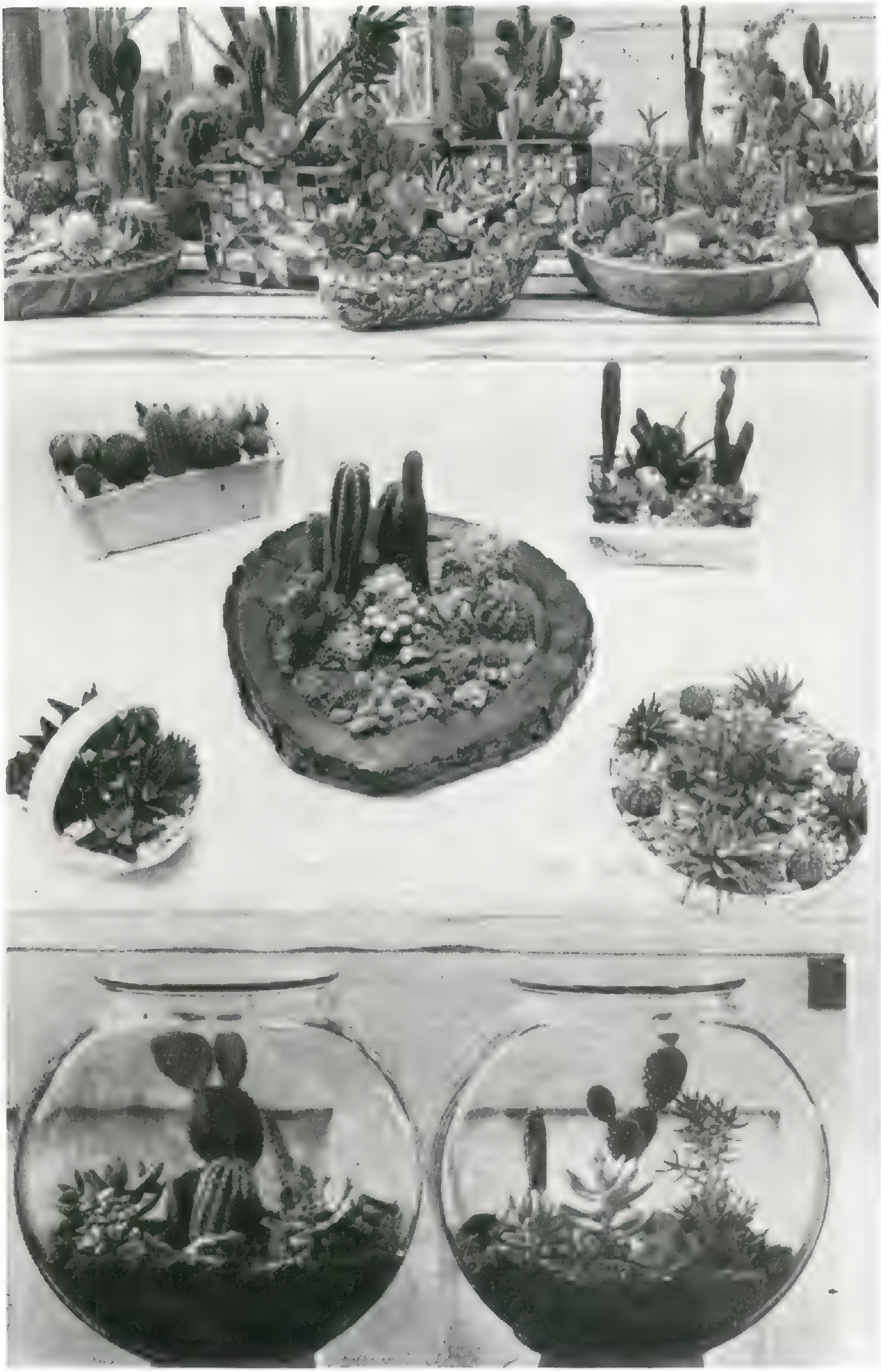
Winter is the season of the year when house plants are perhaps more appreciated than at any other time. When cold weather descends to destroy the beauty of our summer garden, there is no need to go "dormant" on plant life. There are many kinds of house plants that can give and continue to give enjoyment even though the outdoor life has gone to rest! Succulents, above all, please all year round because they always look attractive, healthy and radiant. Succulents lend themselves to house culture without any trouble. Some gardeners may not see any beauty in cacti and other succulents and question keeping them around the house. Of course, this depends entirely upon personal taste. Succulents are usually chosen because they can be grown with such ease. Few house plants require less care and give so much pleasure and satisfaction.

Cacti and succulents can be made attractive on shelves built into the window, or by any other method that appeals to the individual. Alcove windows and sunlit porches are the most ideal locations for growing desert plants in the home, yet it will surprise you to see what a fine lot of plants can be grown in the ordinary window. In the average home, small cacti readily lend themselves to many pleasing arrangements in the window garden, on a table or wherever a touch of interest is needed.

Desert plants need not be confined to pots alone. Small glazed novelty pottery, dishes and bowls, as well as terrariums are for these plants. The very diminutive novelty pots holding but a thimbleful of soil can support slender, tail-like cacti for a surprisingly long time—two years at the least—but at best these containers are only adornments rather than serious attempts at growing healthy specimens. Bowls and dish gardens are more elaborate affairs and invite artistic ingenuity in combining rocks and plants to form a realistic desert scene in miniature. Desertariums are equally attractive, for they are nothing more than glass-enclosed deserts. Truly, they should excite admiration and interest because they are so decorative and different.

MAKING DESERTARIUMS AND DISH GARDENS:

A desertarium can be made easily, yet a certain amount of patience is required. Any clear glass enclosure, such as a bell jar or discarded aquarium will be suitable for the purpose. An inch of gravel should be placed in the bottom, then some pieces of charcoal added to keep the soil sweet and finally two or three inches of good porous soil as discussed under CULTURE, should be added. In planting, avoid overcrowding, use seedling plants about two or three inches high; and, wherever possible, rely on cacti primarily, since they will be more satisfactory than the tender-leaved Sedums, Mesembryanthemums, Crassulas, etc. After planting operations are performed, spread a thin layer of fine gravel on the surface of the soil. It will not be necessary to water immediately, if the potting soil is damp. The plants should not be watered for at least a week after planting. A glass cover placed over the opening at the top will prove beneficial for it will create condensation, especially in the summer season. If one regulates this operation, no watering need be given for weeks. The lid should never be kept on tight (except when condensation is desired to produce rain conditions), so as not to interfere with the



Dish gardens and terrariums.

circulation of fresh air in the miniature greenhouse. Avoid too much moisture, for this becomes an inducement for rot diseases and molds detrimental to successful glass gardening. All terrariums should be placed in well-lighted positions during the day, but at night they may serve as ornaments on the mantel, bookcase, or table.

Dish or bowl gardens can be conversation pieces in any home. You don't even have to be a succulent enthusiast to include one or two dishes in your living room or any other room in the house. They fascinate both young and old. To make a dish garden use any kind of flat dish made of porcelain, plastic or metal. It can be of any size, but the most popular dishes are from ten inches to fourteen inches across. Natural containers like sea shells, cactus wood skeletons and pneumatophoric objects (cypress knees, etc.) are worthwhile to consider if their depth will allow for a handful of soil. The best containers are quite shallow, two or three inches in depth.

The first step after choosing a container is to cover the bottom with about a half inch layer of gravel and upon it place a few sticks or chips of charcoal to keep the soil sweet. A handful of good porous soil is then added, and into this the plants and rocks are firmed in place. Rocks simulate actual habitat conditions and often help in anchoring the plants in shallow containers.

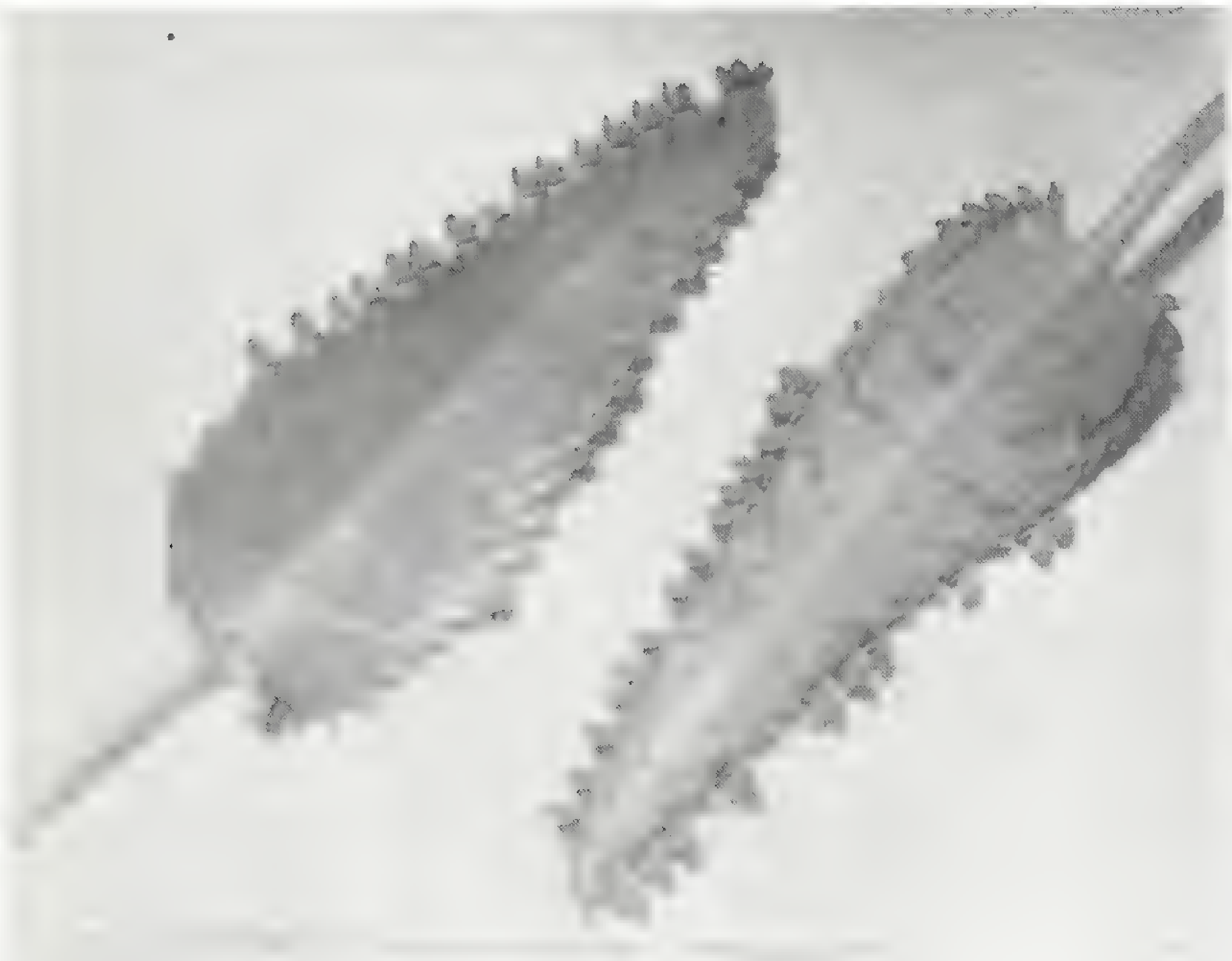
The planting of the dish garden is, of course, a matter of individual taste; however, some knowledge of related plants should be had. A florist-bought dish garden often is a hodge-podge of unrelated plants, especially when aroids, ivy and ferns are used with succulents. Desert plants cannot compete with jungle plants or vice versa. If you water too much the desert plants rot and if you don't water enough jungle plants wither and die.

When making a desert dish garden, use only cacti and succulents that require infrequent waterings. Do not overcrowd the dish with plants because a simple garden, planted with artistic taste, will remain a pleasure for months. Seedlings or dwarf plants should be used since they can easily accommodate themselves to one small container. After the plants are arranged and planted, sprinkle lightly with water and then spread sand, gravel or limestone chat on the surface. Colored sand is used frequently by the florist to create a painted desert effect.

PROPAGATION OF SUCCULENTS

CUTTINGS:

Most succulents propagate very easily, either by stem or leaf cuttings. In some species, certain plants will produce young viviparously along the leaf margins even while the leaves are still attached to the mother plant. When the leaf drops to the ground the attached "babies" immediately take root and grow to maturity. In the Crassulaceae almost every species, including such well known genera as Crassula,



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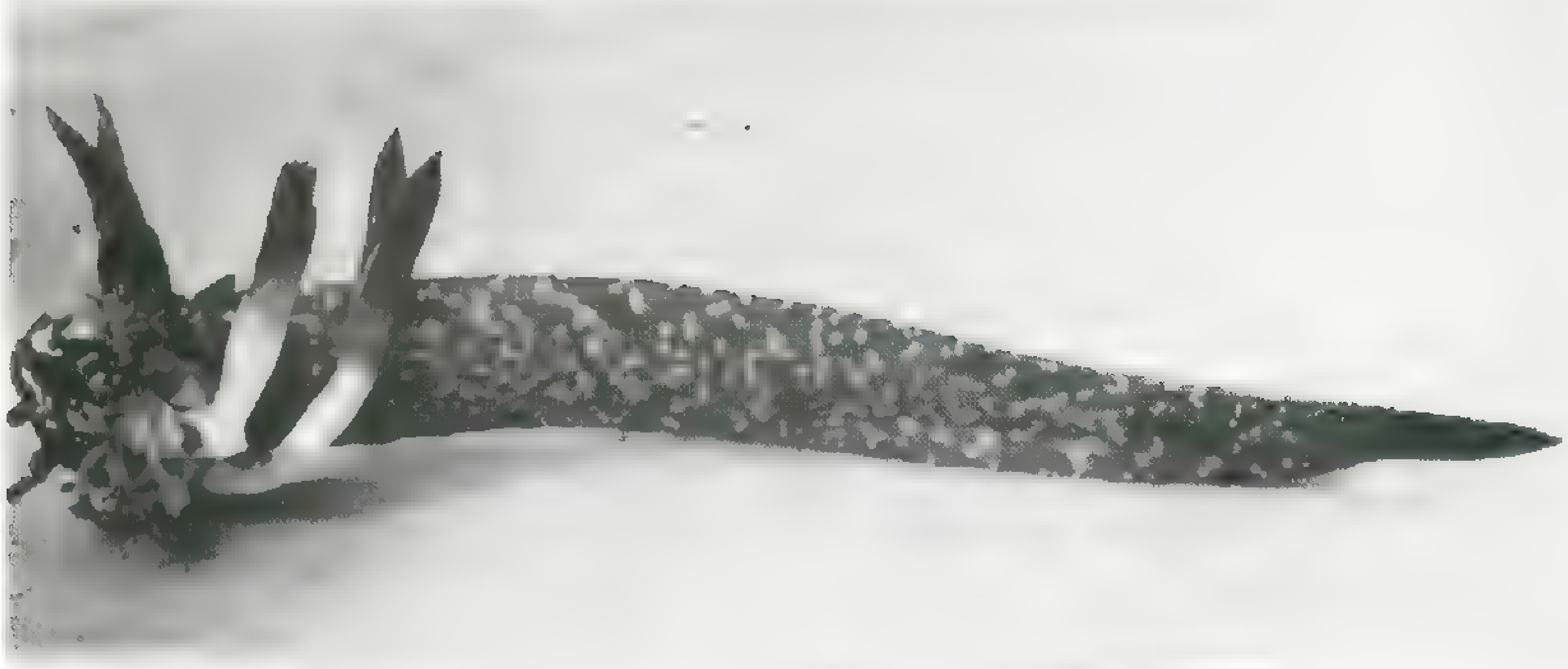

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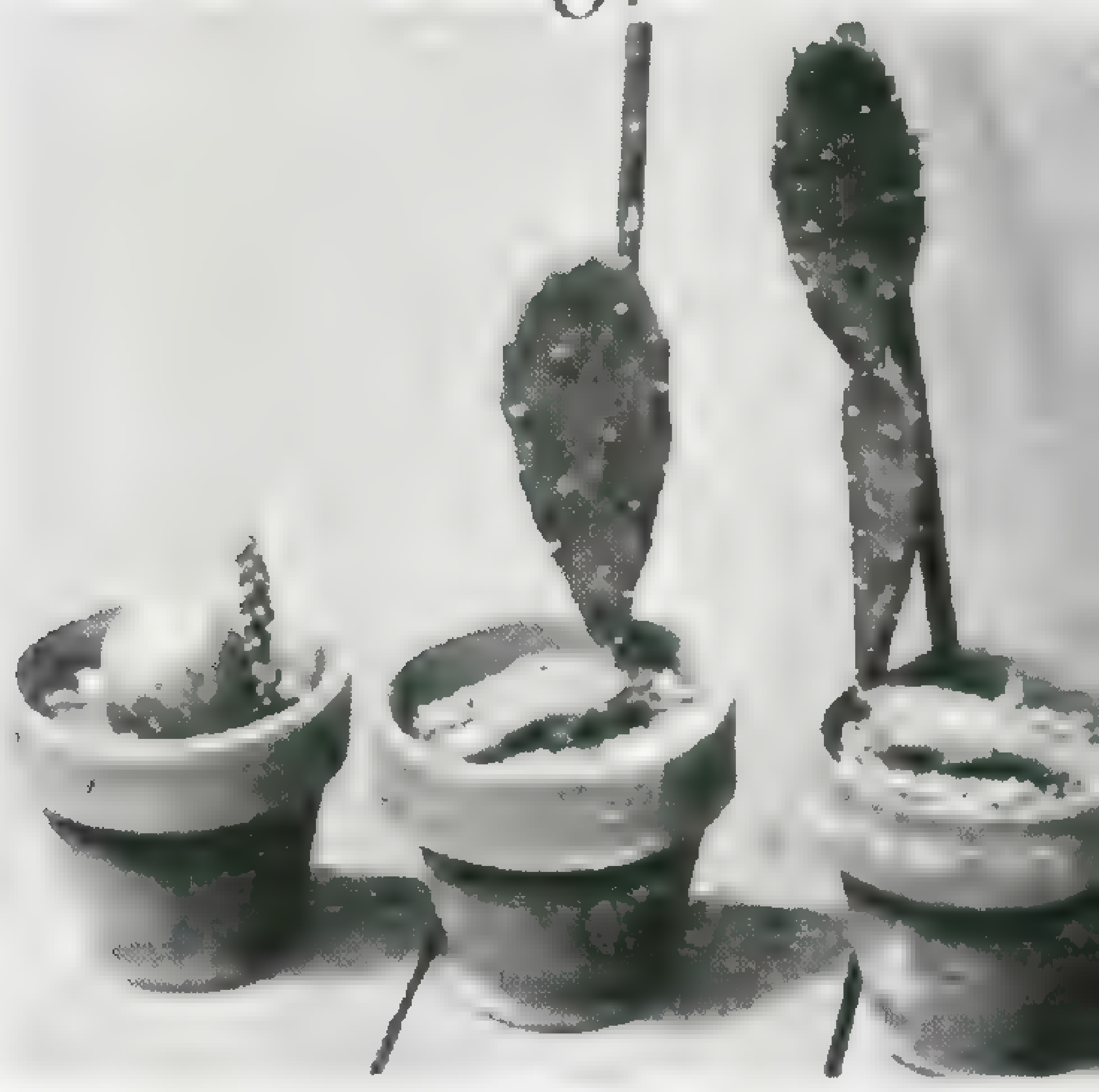

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1. *Bryophyllum daigremontianum* plantlets growing on leaf margin. 2. Gasteria leaf sprouting. 3. Peanut cactus, which can be propagated from each joint. 4. Opuntia fruit propagation.

Bryophyllum, Echeveria, Kalanchoe, Sedum, Graptopetalum and many others, can be propagated readily from leaves. In most instances care should be exercised in removing the leaf with the "eye" (bud) attached, but since the axillary bud is in the base of the leaf in many succulents and the leaves often detach themselves on the merest touch, the operation is simple. *Kalanchoe beharensis* can be propagated from leaves by merely slitting the plush-like leaf and laying it on top of the soil or sand, just as is done with some Begonias. In the Cactaceae the well-known Organ Pipe, *Lemaireocereus marginatus,* and the Bishop's Cap, *Astrophytum myriostigma,* can be propagated from stem ribs alone. Opuntias develop young shoots from small pieces of detached joints as long as at least two areoles are present. An areole is a specialized organ in the Cactaceae, corresponding to a node on other plants, from which leaves, branches, and flowers emerge. It is usually round, minute to large, usually filled with felt, wool, bristles, hair or spines and arranged in symmetrical fashion on the surface of a joint.

Generally, any portion of a cactus and succulent can be cut off, treated and forced to produce new plants. The stem should be cut at the narrowest point possible. The cut surface should be allowed to dry and form a callus before it is placed in the sand or sandy soil for rooting. Plants form a callus on a cut surface when exposed to the dry air for several days or weeks depending upon the size of the cutting. Larger cut surfaces will require a longer length of time to heal. Cuttings need not be watered immediately after placing in sand. The sand, however, should be slightly moist, though not wet. It is best to withhold water for at least a week and then apply it sparingly until there is a sign that the cutting has taken hold. Indication of this will be apparent at the growing tip or at a branch bud somewhere along the stem. If for any reason decay appears cut the slip back to the living tissue and allow it to callus over again.

Cuttings, especially the slender-stemmed varieties, should be shielded from too much sun. Pure sand has the property to produce new roots readily but, since the rooted cutting derives no nourishment from it, it should be carefully transplanted to soil soon after roots have formed. In transplanting the cutting, care should be exercised not to injure the root system. Transplant into moist soil but do not water after planting until the roots have become established.

SEED:

Cacti and other succulents are easily grown from seed. Even though a great deal of patience is required for seedling culture, it is rewarding, for a more fascinating pastime cannot be indulged in.

Packets of seeds of all kinds of succulents can be bought at nominal prices from seedsmen in this country and abroad. The seed can be sown at any time of the year provided greenhouse culture can be given the seedlings in the winter. In the average home where during the winter temperatures frequently fall below 70° F. at night and humidity is low, it is advis-

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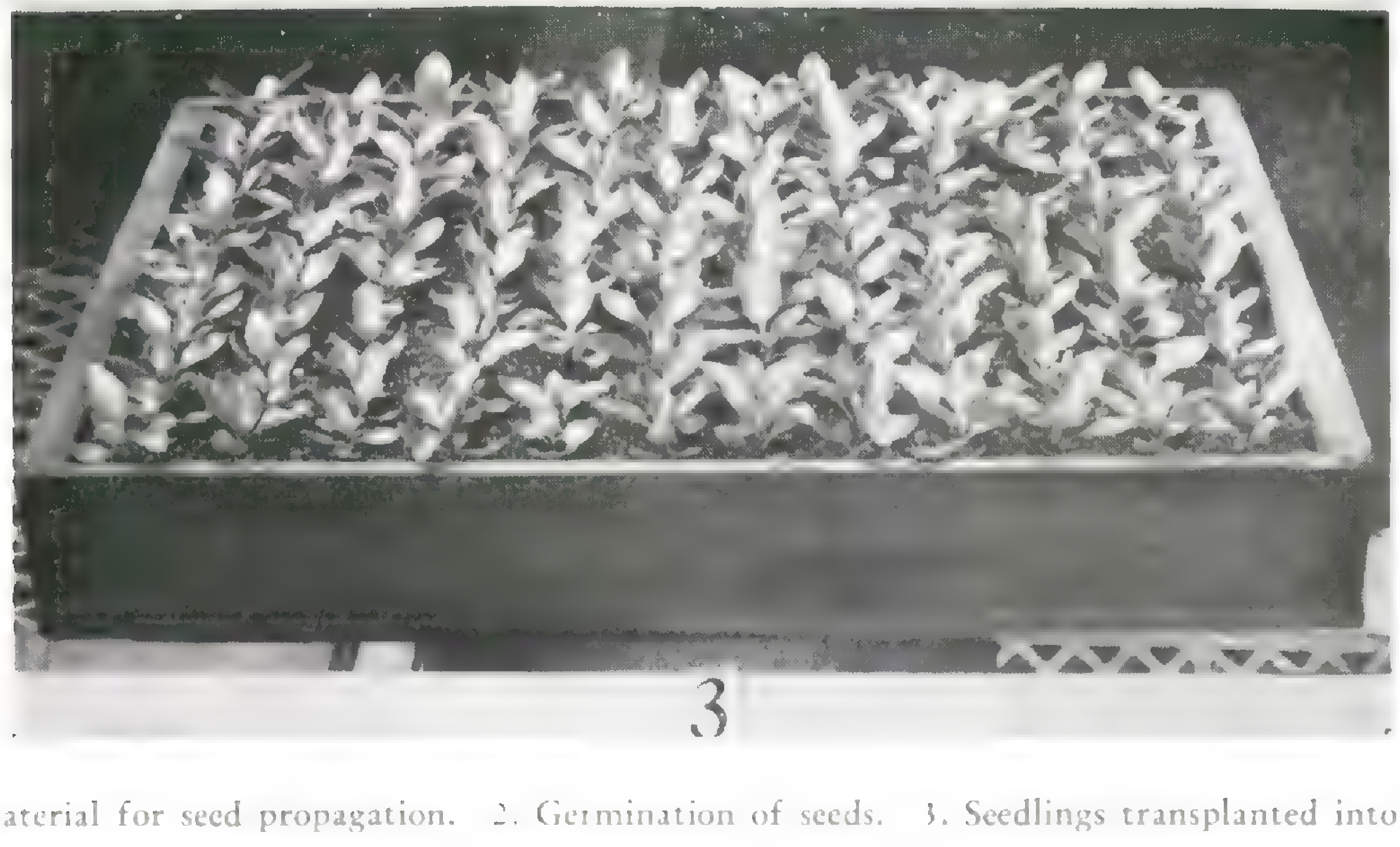

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1. Material for seed propagation. 2. Germination of seeds. 3. Seedlings transplanted into flat.

able to sow the seed any time after the middle of April until the end of the summer season. For best results, a uniform temperature of at least 70° and no higher than 90° should be maintained around the seed pans. Many tropical varieties will probably do better at temperatures higher than 70°.

The seed should be divided according to its size and sown in separate pans or pots. Any container which can be made to drain freely can be used for the purpose; but ordinary flower pots are very satisfactory. Thorough drainage should be provided in the bottom of the seed pan in the form of a generous supply of potsherds or gravel; upon this base, soil should be sifted to within an inch of the top of the pot. Any good porous soil may be used, especially if it contains a mixture of screened sand, well-rotted leafmold, and garden loam in equal proportions. Before sowing the seed, firm the soil with a small wooden tamper. Fine seed need only be broadcast, but the larger seed such as that of Opuntias, Stapelias and Euphorbias should be spaced in rows, giving each seedling a chance to develop after germination occurs. Seed of the other succulents, as a rule, is never covered, except the seed of the larger varieties which may be spread lightly with a coating of sand or sandy soil. It will be found practical to add a light covering of fine gravel over all the seed sown, simply because it will act as a protective blanket from too rapid evaporation and as a support for the tiny plants. After the seed is sown, the soil must be watered by immersing the container in a pan of water, permitting the moisture to seep to the top. Avoid watering from above since the seeds may be floated away unless a very gentle mist-like spray can be created. Care should be exercised to keep the seed and seedlings moist but not soaking wet. The seed pans must never be allowed to dry out. A single watering by immersion will usually suffice for five to seven days, depending upon the conditions maintained around the containers.

After the seedpans have been moistened, a white-painted glass cover should be placed over them and the pans set in a well-lighted position in the greenhouse, in the window, or under fluorescent light. The glass lid helps to maintain an even temperature and prevents the soil from drying out too rapidly; and, as well, it shields the young plants from the direct rays of the sun. As fresh air is very essential, especially in checking the growth of fungus growth which may make its appearance (unless soil and seeds are sterilized), it is important to remove the cover for at least an hour each day.

Most seed, especially of Stapelias, Mesembryanthemums, and the like will germinate within a week or fortnight; other seed may take a month or several weeks. When there is no sign of germination within five months, it is an indication that no or very little germination will occur. It is best to discard the seed and try again.

Early transplanting is not necessary unless the tiny seedlings begin to crowd each other. The plantlets may be transplanted into flats or larger pots, but care must be taken not to injure their fine roots. It is advisable not to water the transplanted seedlings for at least two days in order to safeguard against the possibility of bacterial rot which might result from accidental injury to the rootlets during the shifting process. Also keep the newly-transplanted plants in a shady location for a few days before subjecting them to strong sunlight. Frequent shifting is to be avoided, since the procedure will not necessarily speed the growth of the individuals. Some succulents grow fast, others very slowly. Cacti, as a rule, do not require as frequent transplanting as do other familiar succulents, such as Mesembryanthemums, Aloes and Agaves.

GRAFTING:

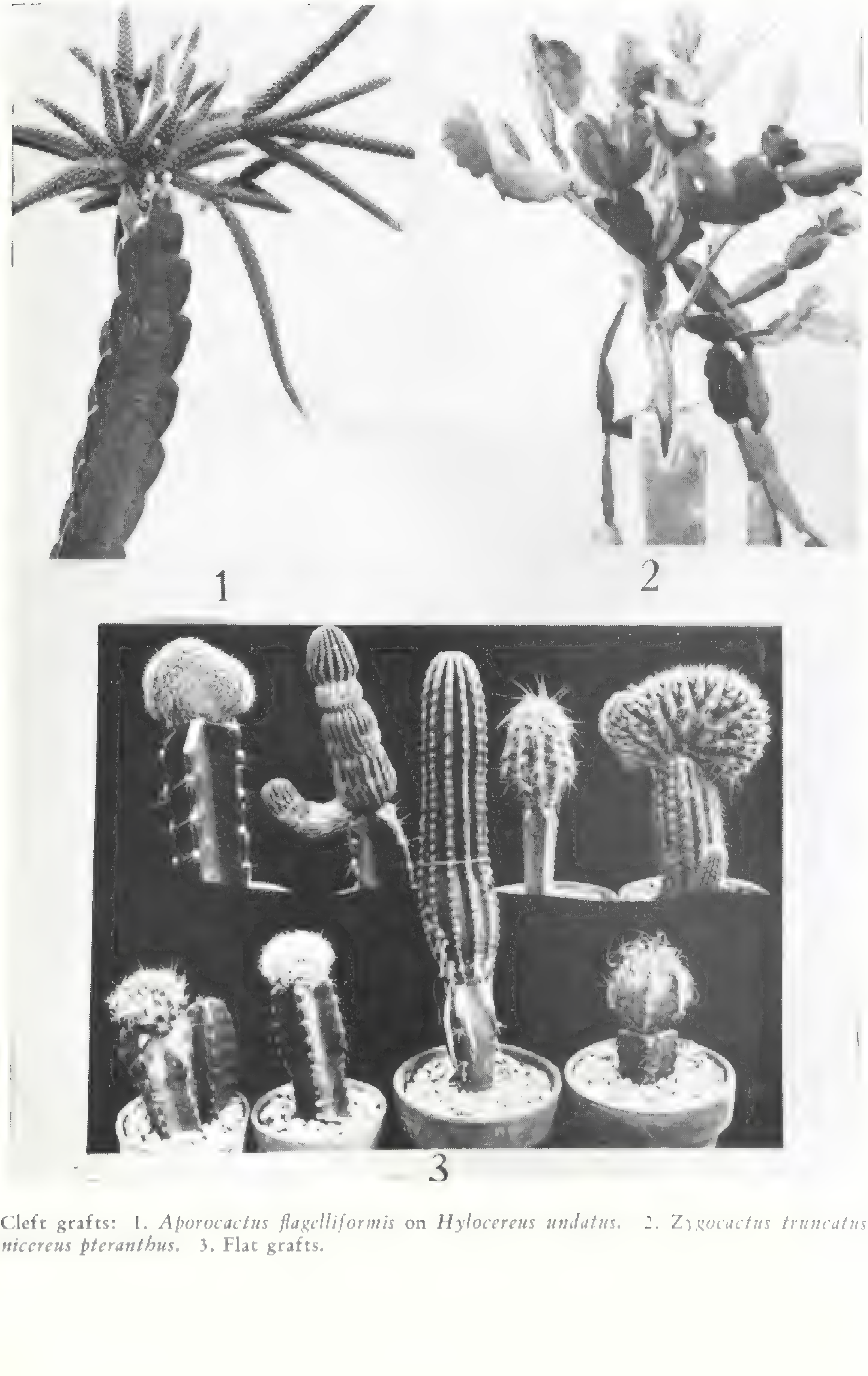
Another very interesting method of successful propagation and one that is recommended to those who seek the unique in plant culture is plant grafting. The inexperienced person usually becomes discouraged or may not even attempt this experiment, because it seems difficult of accomplishment. Truly, grafting is an art, but it is by no means difficult to execute if a few simple and essential rules are observed.

By grafting, it is possible to unite two separate and distinct plants and make them grow as one. There are several good reasons why grafting of succulent plants is encouraged. It speeds the growth of those plants which are naturally slow-growing; it hastens smaller seedlings to maturity; it is the means of preserving rare species which might be lost through decay; and it insures a good crop of flowers on plants which seldom bloom when grown on their own roots under artificial cultivation.

Cacti, Euphorbias, and Stapeliads are generally used for grafting, because their stems are full of sap, thereby making them excellent for unions. Other succulents, however, can be used almost as successfully. Only related forms can be grafted, such as cacti on cacti, or spurges on spurges.

All slender-stemmed varieties lend themselves to cleft-grafting, while the thick, globose types require a flat graft. Both of these methods are of simple operation. In cleft-grafting, the stock should be cut to a desired height, usually six to twelve inches, and a slit made at the top with a clean, sharp knife or razor blade. The scion is cut at an angle on both sides to form a wedge, and this portion is inserted into the slot of the stock. A thorn from a Pereskia or Opuntia is run through the united portions and finally the graft is closely wrapped with twine to prevent the slit from drawing apart.

When using the flat graft, both scion and stock should be the same width at the contemplated union. After selecting the two plants, it is only necessary to make a smooth, flat cut on each individual and then to set the scion upon the cut surface of the stock. To hold the two plants in position while they are knitting together it is advisable to run binding twine over the graft and under the pot or to make use of any other holding device in order that a perfect union may be realized. Freshly-grafted plants should be set in a moderately warm place in the shade, so that the cut surfaces may grow together firmly and evenly.



Cleft grafts: 1. *Aporocactus flagelliformis* on *Hylocereus undatus.* 2. *Zygocactus truncatus* on *Selenicereus pteranthus.* 3. Flat grafts.

PLANT FAMILIES WHICH HAVE SUCCULENT MEMBERS

Cactaceae (cactus family)

The Cactus family is, without doubt, the most remarkable and outstanding of all the succulent plant groups. Its more than two thousand species and varieties, since they are all indigenous to the Western Hemisphere only, are truly more American than all the rest of the xerophytes (dry-climate plants). A Rhipsalis has been found in Africa but whether it is really a native is still a conjecture. Yuccas, Agaves, Echeverias and several other dry-loving plants likewise claim American citizenship, but they are only small groups within their families which have relatives in other parts of the world. Only the Cactus family is the All-American family among the Succulents! However, their popularity has carried them into the homes of every land on this globe. Cacti have escaped from cultivation and have established themselves so securely in the dry regions of Africa and Australia that they have become a great nuisance for everybody concerned. So, too, have they become so extensively naturalized in Europe, Asia, and Madagascar that they can hardly be distinguished from the native flora.

The fascinating Cactus family is best divided into three distinct tribes each of which is subdivided into subtribes, genera, subgenera, species and varieties.

The first of the three tribes universally recognized in the Cactus family is the Pereskia tribe or *Pereskiae*. Members of this tribe, numbering about twenty species, are assumed to be the most primitive of the cacti.

For the most part they are woody and leafy trees, shrubs, and vines which do not in the least resemble cacti as we generally know them. Many of the arborescent Pereskias could easily be mistaken for Lemon or Apple trees. However, since they bear areoles from which spines, branches, and leaves arise, they are *true* cacti. The areole is the distinguishing feature of every cactus plant. These areoles are scattered over a plant body in more or less symmetrical fashion and correspond to the places on the branches of a tree from which other branches, leaves and flowers grow. The foliage of Pereskias is mostly non-succulent, deciduous or permanent. Their flowers are stalked and often grow in clusters. *Pereskia aculeata* is the best known member in the tribe and was cultivated in England as early as 1696.

The second tribe, the Opuntia tribe or *Opuntieae,* best displays the evolutionary trend from the preceding group which can easily be followed in its eight or nine genera. Glochids are the distinguishing feature of the second tribe. These are tiny barbed bristles which fill the areoles and cause so much discomfort to the person handling the plants. These glochids or "bundles of tiny spines" are easily dislodged from the plant, but are withdrawn with difficulty from clothing or flesh. The genus *Pereskiopsis* becomes the second evolutionary step up in the Cactus family. The trees and shrubs are very similar to *Pereskia* but must be excluded from the first tribe because they bear glochids. The most famous members of the Opuntia tribe are the "Prickly Pears" and the "Wicked Chollas." The former are characterized by flattened leaf-like joints or pads (branch sections), while the latter possess cylindrical stems. Opuntias have the widest geographical range of any cactus group. They can be found in Canada, the United States, Mexico, Central America, most of the warm Western Hemisphere islands, and extend to the southernmost tip of South America.

The third tribe, the Cereus tribe or *Cereeae*, is the largest of the three. It contains the darlings of the Cactus family, ranging from the dwarf to the gigantic, and likewise it is the most complex in its entirety. There are no glochids in their areoles, the plants are usually leafless and the flowers, as a rule, possess definite tubes. Over one hundred genera are included in this tribe and nearly a thousand species. The showiest and most brilliantly colored flowers grow from the highly succulent stems of the Cereus tribe. Many bloom for only a few days, some for only one night, and few for a few hours.

Although the Cactus family is very rich in varieties of shape, form, color and size, the genus Mammillaria is probably the most popular among the amateur cactus fans. Its members are, for the most part, small plants with simple or often clustered cylindrical or globular bodies, conspicuously covered with numerous tubercles or nipples. The nipples are capped with areoles, from which spring forth delicate or strong spines of various sizes. The flowers, however, do not arise from the areoles but are rather borne from the usually hairy or wooly axils of the old tubercles near the tops of the plants. The flowers are comparatively small, more or less campanulate, yet they make up for their diminutive size by being produced in abundance in the form of a dazzling crown of red, pink, white, yellow or purple. The beauty of the plants is further enhanced by the colorful clavate (club shaped) fruits, which in some species, appear at the same time as do the flowers.

Epiphyllum × "Prof. Ebert." A magenta-flowered orchid cactus suitable for small pots.

The neophyte or beginner, who is contemplating a collection of cacti, should acquaint himself with a book or two on the subject before purchasing a lot of unwanted or difficult plants. There are over two thousand kinds of cacti with varying good and bad qualities. Some are thimblesized, others veritable giants; some are slender, twining, creeping or prostrate, while others are shabby, weedy and even obnoxious, there are varieties that will test your skill as a gardener. By studying good illustrated and descriptive catalogs and reading such instructive books as my own CACTUS GUIDE (Van Nostrand, 1956) and CACTUS PERSONIFIED (Wildcrafter Publications, 1959), one can get a fairly clear idea of what types of plants will be best suited for a particular room, porch, or garden. Both of these books can be purchased at the Missouri Botanical Garden.

EUPHORBIACEAE (SPURGE FAMILY)

The Euphorbs or spurges constitute a very large family including herbs, shrubs, and trees of the most varied aspect and are found in most parts of the world. The plants are characterized by a milky juice, "latex," and the flowers are often imperfect, lacking petals. The desert Euphorbs are more or less succulent in habit and many are strikingly similar to cacti. Some are dwarf leafless shrubs and others become giant trees sixty feet or more high. These desert spurges survive by reason of their power to store water and nourishment not only in their roots, but some in their main trunks and branches as well. Many of the strange shapes are paralleled among the cacti and consequently many people usually mistake these spurges for cacti. Most of the succulent Euphorbias are of African origin, although a few will be found in India and Arabia.

King Juba of Mauritania (ca. B. C. 25–18 A.D.) was the discoverer of a plant to which he gave the name of *Euphorbia* in honor of his physician, Euphorbus.

The genus *Euphorbia* numbers around 2,000 species and these are herbs, shrublets, shrubs or trees of most variable habit, herbaceous, woody or succulent, and spineless or spiny. South Africa is the home of about two hundred succulent species; and all of them are appealing. The Missouri Botanical Garden has a rather large and interesting collection, most of which were grown from seed about twenty-five years ago.

It would be impossible to adequately describe a representative number of spurges in this bulletin and again the writer would like to recommend a treatise which is very valuable for the collector. The two-volume work is White, Dyer and Sloane's THE SUCCULENT EUPHORBIEAE published in 1941 by the Abbey Garden Press. This is the most extensive monograph on the South African spurges—well illustrated, with good descriptions, and full of historical information.

One of the most popular spurges is *Euphorbia Tirucalli,* at one time thought to be a producer of rubber but the coagulum contains too much resin. This spurge has an odd and engaging form of growth and is easy to cultivate. In fact, few plants can be naturalized more easily in new surroundings. The plant is composed of slender green cylindrical branchlets and it early becomes tree-like up to thirty feet tall. Along the Atlantic seacoast in Florida it is frequently used as a hedge.

Euphorbia bubalina is another favorite. It is a succulent shrub, spineless, and easily propagated from cuttings. When planted in a greenhouse it will flower and seed regularly and seedlings will appear everywhere.

The most prolific spurge in collections is *E. lactea* from the East Indies. It produces branches that are more or less triangular in cross-section, the three ridges along the side of the stem have wavy margins and the central part of the stem between the ridges is white-mottled. A crested form of *E. lactea* is highly prized and is often called the Frilled Fan Spurge. Another common form often found in most collections is the Crown of Thorns, *E. splendens,* native to Madagascar. It grows into a small bush and bears green leaves and flowers almost the year round. Still another choice is *E. pseudocactus,* with highly mottled stems.

The genus *Pedilanthus* is strictly American, found mostly in Mexico. It has cylindrical stems and branches, at the tips of which are produced colorful inflorescences in the shape of slippers, hence the common name "Slipper Spurge" for the plants. The curving branches are frequently used in floral arrangements, especially when the colorful crinkly foliage is present.

ASCLEPIADACEAE (MILKWEED FAMILY)

This is a most interesting family of about two thousand species scattered in all parts of the world. It is known as the Milkweed family because all plants produce a milky, semi-milky to slimy watery juice in their cells. Only the Stapeliads and Ceropegiads are highly succulent and these occur mostly in Africa.

The Stapeliads grow in simple or multiple clusters and are characterized by short, mostly toothed, fleshy stems on the order of dwarf cacti of the Cereus group. The flowers are campanulate to starshaped with often lurid colors. They also produce a more or less fetid odor which serves as a lure for desert flies—the principal agents for their pollination. None of the Stapeliads are found in the Western Hemisphere. They occur on the African continent from the Sahara wasteland to the Cape of Good Hope. In Asia they are usually confined to India, Afghanistan, Arabia, Ceylon, Palestine and some of the islands of the Indian Ocean. A few varieties are native to Spain. The Stapeliads consist of about twenty genera, the best known being *Stapelia, Caralluma, Duvalia, Huernia, Hoodia, Piranthus, Tavaresia* and *Trichocaulon.* In order to study them and gain much valuable information the reader is referred to White and Sloane's THE STAPELIEAE in three volumes published by Scott Haselton in 1937.

The Ceropegiads contain mostly vining leafy succulents although a few are erect and rigid in growth, forming clumps. The flowers may be described mostly as lantern-like. One of the most popular Ceropegiads is *Ceropegia Woodii* which has small silver-mottled heartshaped leaves or string-like stems. *C. Sandersonii* possesses much larger and thicker leaves and its flowers resemble parachutes. *C. stapeliiformis* is a leafless climbing or clambering species with long thin cylindrical stems with mottled markings. The peculiar white flowers have brown edges.

Another familiar milkweed is the Wax Plant or Hoya.

Liliaceae (lily family)

There are many kinds of desert lilies of succulent or xerophytic habit, notable among them the Aloes, Haworthias, Gasterias, Yuccas and their immediate allies. The Lily family is a large one, found in many parts of the world but all its members are not classed as succulents. The Yuccas are mostly xerophytes. These plants play an important part in the development of home grounds in the southeastern sections of the United States, particularly in Florida. In warm, sunny California these slender green dagger-lilies are frequently utilized in foundation plantings and look particularly effective against the Spanish type of architecture. Tall, arborescent Yuccas often stand as sentinels above the low adobe ranch houses of the Southwest. In the colder regions, above the Mason-Dixon line and throughout the Midwest, these plants serve as backgrounds in the rock garden, while the more tender varieties are used as ornamentals in summer gardens and conservatories. The few stemless or short-stemmed hardy members often are seen in cemeteries, along railroad embankments, in abandoned fields and waste places. Almost all of the subtropical species are adaptable to pot culture when in their young stage, making excellent window plants.

At present there is no modern work that deals with all the Yuccas, but Susan D. McKelvey's Yuccas of the Southwestern United States in two parts will be of invaluable aid to Yucca lovers. The first part was published in 1938 and the second part in 1947.

Aloes constitute one of the big groups of succulents in the Lily family. The leaves are very fleshy and are usually crowded into a dense rosette. Some Aloes do not produce a stem, while others assume tree-like proportions. The majority of them can be placed outdoors in summer in a sunny place. In California and other warm regions these plants are used as outdoor adornment in beds, foundation plantings, in borders and as screens. Aloes require a rich sandy soil and good drainage. They grow very readily from seed but since they hybridize so easily propagation by seed does not always produce true species. Many varieties produce an abundance of offsets which can be taken off and potted individually. Aloes are found mostly on the African continent. In South Africa, alone, over one hundred species are recorded. *Aloe vera* possesses medicinal properties and has been used from time immemorial for purgatives. In recent years it has found favor as a remedy for burns, particularly those caused by X-ray and radium. Here again I recommend specialized literature for those who wish to study these particular plants. The best work is THE ALOES OF SOUTH AFRICA by Gilbert W. Reynolds, published in 1950, and containing over 500 pages with many black & white as well as color plates.

Closely allied to the Aloes are Gasterias and Haworthias which find favor as window plants. Though they are much smaller, they readily hybridize with Aloes. The Gasterias usually possess two-ranked, tongue-shaped leaves and the flower spikes exhibit tubular reddish flowers with green tips. Haworthias are very close relatives and are very diminutive succulents, often referred to as "the darlings of the succulent clan." They are grown mostly for the symmetrical rosettes of dark green warted leaves or bright green translucent foliage. Haworthias require shallow pots. They flower almost any time, although the flowers are often unattractive.

AGAVACEAE (AGAVE FAMILY)

Agaves have long been considered attractive plants for the outdoor garden. They prefer heavy soil that is well drained in a sunny location. Although strictly American in origin the plants have been naturalized in India, the Philippines, Africa and many other tropical regions. The plants are erroneously but popularly called "Century Plants" because it was long thought that it requires 100 years for the plants to bloom. This is far from being true. Some Agaves bloom annually; others may take eight to twenty-five years to reach maturity, but since in collections the plants may not bloom for two or three generations the fallacy has arisen and has been perpetuated. The leaves of the Agaves all possess fibers and some of the species such as *Agave sisalana* and *A. fourcroydes* produce the *sisal* and *henequen* of commerce.

The leaves of the Agaves grow in more or less rosette fashion. They are usually very firm, hard, with margins entire or toothed and usually with a strong spine at the tip. Some of the Agaves are dwarf but others attain gigantic proportions. Most of them sucker freely and are excellent pot specimens although they often outgrow their containers in no time. *Agave atrovirens* is the source of *pulque*, a most potent drink in Mexico; other species are used to make the distilled drink, *tequila*.

The flowerspike resembles an asparagus shoot and it grows fast, in some species assuming tree-like proportions up to twenty feet high and several inches in thickness in several weeks. Some species die after flowering but innumerable offsets are produced before the plant's demise. Formerly Agaves were included in the Amaryllidaceae or Amaryllis family but in recent years a separate family was proposed for them and is now universally recognized. There are no up-to-date popular books on Agaves available at present in the English language but botanical libraries do possess classics by such specialists as William Trelease, Baker and Rose. This is one of the most difficult plant groups to revise and anyone attempting a revision of Agavaceae will have many problems to solve.

AIZOACEAE (FIG-MARIGOLD FAMILY)

The genus *Mesembryanthemum* was established by Linnaeus in 1753 and it contained a complex assemblage of stemless as well as shrubby plants. The genus remained intact until 1921 when a wholesale division was started by Dr. N. E. Brown in *The Gardeners' Chronicle*. Today at least a hundred different genera are recognized. The vast number of succulent species of the Fig-marigold family are inhabitants of South Africa's driest regions and the plants have adapted themselves to these conditions by storing up water for the dry season and have taken the many odd forms which make them so interesting.

The Mesembryanthemums are divided into two groups: the shrubby or carpeting members such as *Carpobrotus*, *Delosperma*, *Dorotheanthus* and *Drosanthemum* all of which produce veritable carpets of beautiful daisy-like flowers in various colors; and the "Stone Plants" such as *Pleiospilos*, *Lithops*, *Conophytum* and *Gibbaeum* which are usually stemless and can hardly be distinguished from the stones among which they grow. They, too, have lovely flowers in various shades. In this same category are included the "Windowed Plants" like *Fenestraria* and *Frithia*, which have retired into the ground and receive their light through the flat translucent tops. The stemless Stone Plants generally are harder to maintain because growers tend to overwater them. Pots too large or too deep should be avoided and the containers must be of porous earthenware. Transplanting is not necessary and the plants can be kept in the same pot for several years. The less the plants are disturbed the better. All Mesembryanthema prefer a sunny location and do excellently in greenhouses although healthy specimens can be grown on the windowsill as well.

Lithops or Stone Faces from South Africa. Photo by Ladislaus Cutak.

The stemless Mesembs often present the phenomenon of mimicry in their native haunts. When not in flower some of these plants are hard to detect. The Lithops resemble curiously-shaped pebbles and are commonly known as "Pebble Plants"; the Pleiospilos present succulent leaves of the color of weathered stone and when not in flower look like lumps of stone, hence the common name "Stone Plants" or "Split Rocks." The Titanopsis present leaves in tiny rosettes and their surface is covered with irregular excrescences that look exactly like whitish fragments of limestone. There are a number of books dealing with specific plants of the Fig-marigold family but a general book useful to the fancier is MESEMBRYANTHEMA by N. E. Brown, A. Tischer and M. C. Karsten, published in 1931.

CRASSULACEAE (STONECROP FAMILY)

The Stonecrop family, like the cactus, is generally classified as all-succulent and the botanical name literally means thick or succulent from the word *crassus.* The family is worldwide and contains both hardy and tender plants of variable habit and form. It is also a very large family and is conveniently divided into groups such as the Sedoids, the Kalanchoids, the Sempervivoids, the Echeveroids and many others.

Most plant lovers are acquainted with Sedums and Sempervivums which are wonderful subjects for any rock or wall garden. These two groups are perfectly hardy although Sedum also contains many tropical species. There are more than five hundred species of Sedum classified but many of these are not known to the cultivator. *Sedum acre* is one of the commonest of hardy low-growing mat types as is also S. *sexangulare.* Both of them produce yellow flowers in the summer months. The home grower will probably be interested in the tropical kinds, most of which emanate from Mexico. These are highly colorful and shrubby for the most part. The Golden Sedum, S. *Adolphii,* with pointed yellowish leaves and white flowers, makes an excellent pot or basket plant. The thick leaves break off easily and produce young plants readily. One of the most colorful Sedum is S. *rubrotinctum* (the S. *guatemalense* of horticulture) with deep green, very shiny leaves which turn a bright cherry red when exposed to the sun. It is a great favorite in California.

The Sempervivums are mostly European and will withstand freezing weather. They produce symmetrical rosettes of dark green often tinged purple at the tips. Known as Houseleeks, these plants often are grown on roofs of huts in Europe. In American gardens, Sempervivums are grown in rockeries and strawberry jars. One of the oddest is S. *arachnoideum* which produces white cobwebby hairs amongst its small rosettes. A wall completely covered with these spider hen & chicks is really a sight to behold! The tender Sempervivoids are mostly found in the Canary Islands and are usually classified as Aeoniums. Most of the Aeoniums are sturdy-stemmed, shrubby species producing leaves in a rosette and panicles of showy yellow flowers in pyramidal fashion. An excellent pot or basket plant is *Aeonium Haworthii* with green leaves edged with red. One of the most remarkable is *Ae. tabulaeforme* with large plate-like rosettes. Other more dainty Sempervivi are

Aichryson, Monanthes and *Greenovia.*

In the Echeveria group you will find some of the most colorful leaf forms as well as colorful flowers. The Hen-and-Chick plants are mostly found in Mexico and often look like small cabbages. *Echeveria secunda* is a familiar species often used in bedding as well as in strawberry jars. Some species are glaucous, others hairy, and still others glabrous. Some are dwarf and nearly stemless, others branching and shrubby. Closely related to the Echeverias are Pachyphytums which readily hybridize with them. Dudleyas also belong to this group and are characterized by extremely white-powdered leaves; *D. pulverulenta* the best known Dudleya, is sometimes popularly called "Chalk Lettuce."

The Kalanchoids have become very popular in the past few years. The two well-known genera, *Kalanchoe* and *Bryophyllum,* are grown extensively in America, both as pot plants in the North and in outdoor gardens in the South. The Kalanchoes usually have upright or erect flowers while Bryophyllums have pendent flowers and the leaves often give rise to tiny plantlets along the crenations. *Bryophyllum daigremontianum* and *B. tubiflorum* propagate prolifically and often become a nuisance on a greenhouse bench. *B. Fedtschenkoi* has been frequently used in flower arrangements. *B. pinnatum* is naturalized in all the more or less tropical parts of the world. The Bryophyllums are mostly natives of Madagascar. Kalanchoes contain over two hundred species and are more widely scattered over the warmer parts of the world. *Kalanchoe tomentosa* is a very beautiful plant with narrow, gray, brown-edged leaves. *K. beharensis* grows into a medium-sized tree with large, broadly arrow-shaped leaves. Many of the Kalanchoes produce beautiful flowers which make them extremely popular as house plants. *K. flammea* and *K. Blossfeldiana* belong to this category and their brilliant flowers are borne in large, compact, somewhat flattened clusters.

The Cotyledon group contains quite small plants such as *Adromischus* and the strong-growing, bold-appearing plants such as *Cotyledon.* The Adromischus make ideal pot plants and although only a few species are available all are worth cultivating. Cotyledons are mostly South African succulents and are quite variable in habit, in the size and shape of the leaves, and in the color of their flowers.

The Crassulas number over two hundred species and form one of the most interesting groups in the Crassulaceae. The abundance of forms available is enough to intrigue anybody. Some Crassulas have the appearance of club mosses, others become large shrubby plants, a few form flat rosettes, and still others form dense mats. *Crassula argentea* is the well known Jade Plant and in its native home will often attain a height of twelve feet. It is used extensively in bowls and dish gardens.

MISCELLANEOUS SUCCULENTS

The preceding plant families contain a preponderance of succulents but there are still many more with lesser amounts. In the *Portulacacea* or Purslane family there are two highly succulent genera and these include *Anacampseros* and *Portulacaria*. The former are interesting and fascinating little plants while the latter is a shrubby ornamental frequently found in collections and used in dish gardens and arrangements.

In the *Compositae* or Daisy family only three genera have succulent species and these are *Kleinia, Othonna* and *Senecio*. *Kleinia articulata* is probably the most familiar of the group. It is composed of short joints which resemble a tallow candle. *K. radicans* is a low creeping form and *K. tomentosa* is most unusual in that it is a truly white plant due to the heavy covering of white, felt-like tomentum on the leaves. Still another unusual one is *K. pendula* which resembles a mass of writhing snakes. Commonly it is known as the "Inch Worm." *Othonna crassifolia* is the well known "Pickle Plant," so called because of the small pickle-shaped leaves strung on long slender stems. Bright yellow daisy-like flowers are displayed by Othonna throughout the season.

One would not ordinarily expect to find succulent species in the Vitaceae or Grape family, yet there is the genus *Cissus* with about five members. Two of them are vining or clambering types with angled jointed stems; the other three have greatly enlarged bases and are more or less branched at the top. In the *Apocynaceae* or Dogbane family the highly succulent genus, *Pachypodium*, presents a fantastic group of plants with tuberous-thickened stem-bases looking like inverted carrots. The genus *Adenium* is even more bizarre with its thickened, contorted stems.

Among the Pelargoniums in the *Geraniaceae* a few succulents are found. The oldest in cultivation is *P. echinatum* with round green spiny stems and dainty light colored flowers on long flowering stems. It grows easily from cuttings but the plants require little watering especially in the dormant season.

The *Commelinaceae* or Wandering Jew family contains a few succulent species, the best known being *Tradescantia navicularis* from Peru. Then there is *Cyanotis somaliensis* and some of the Setcreasias are classed as semi-succulents.

The *Piperaceae* or Pepper family is noted for a number of succulents, chief among them Peperomias or Pepper-elders. *Peperomia dolabriformis* is a truly desert succulent, with thick, hatchet-shaped leaves. Others such as *P. tithymaloides* and *P. obtusifolia* can be classed as semi-succulents.

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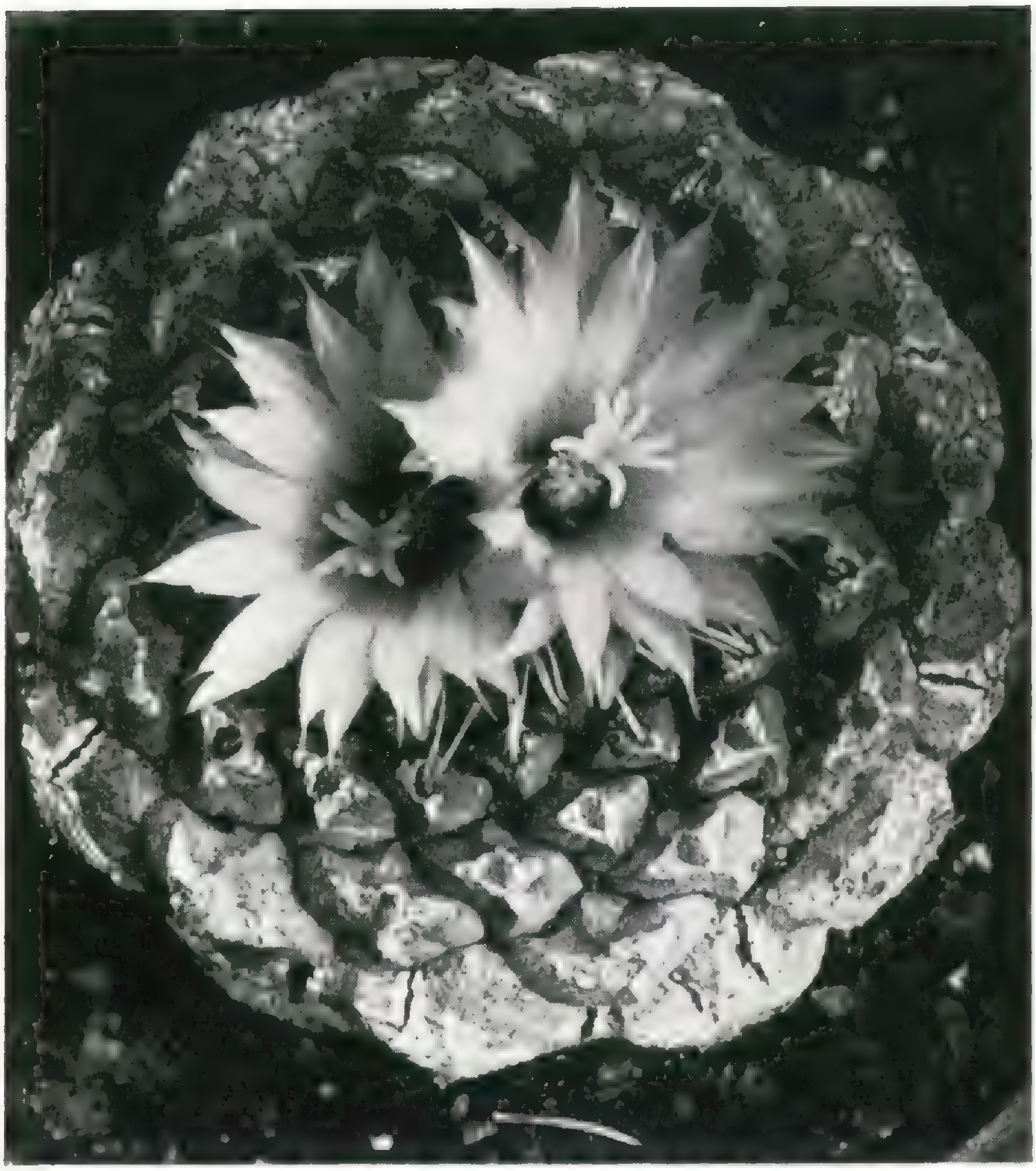

Strombocactus disciformis.

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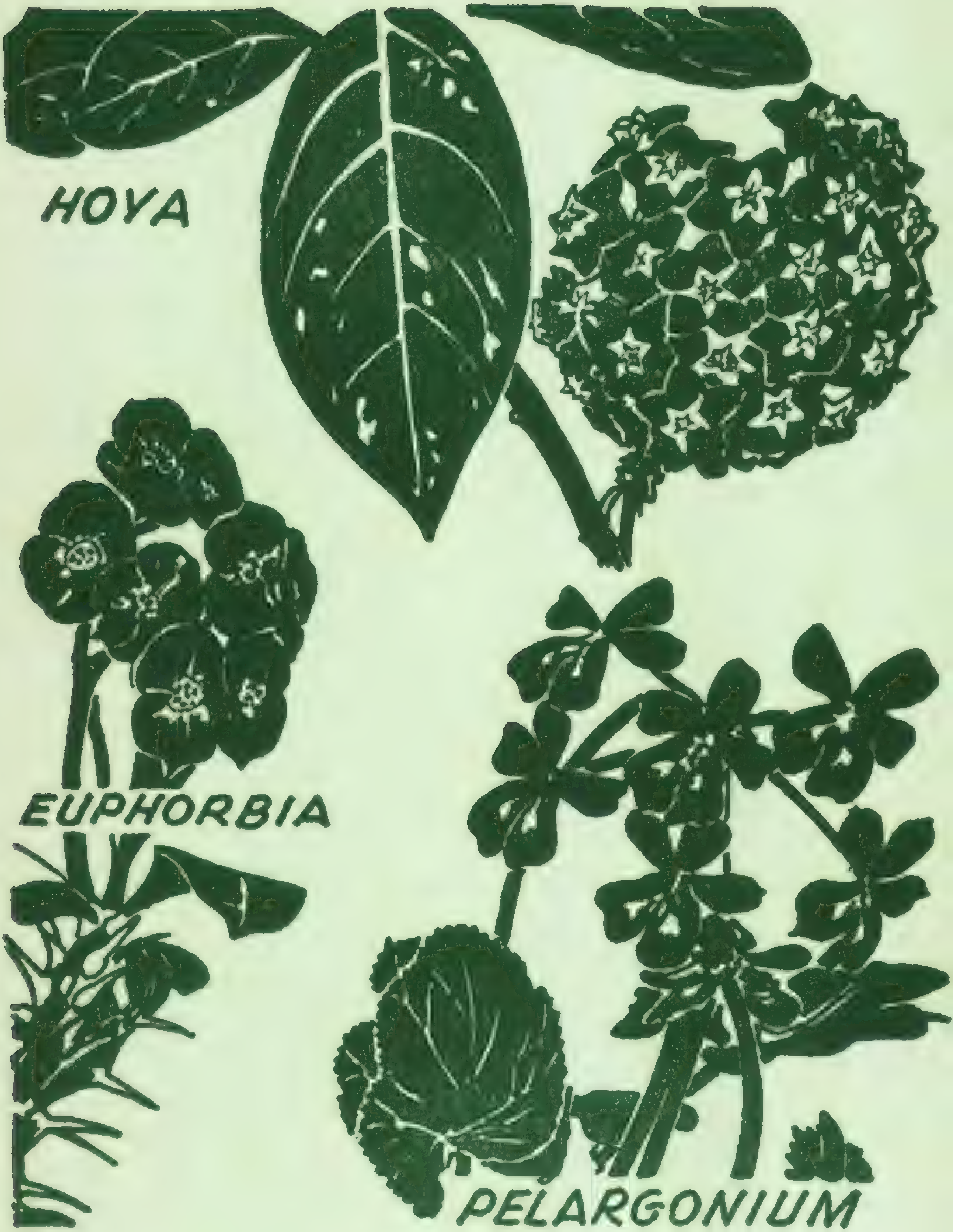
HOYA
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Number [illegible]

CONTENTS

ittle-known Facts on a Well-known Plant

eport on the New Greenhouse Construction in the Missouri Botanical Garden

hat's in a name?

lanting in the Climatron

ow Nature Prepares for Winter

ook Review

unior Research Teams of the Pitzman Nature Program

MISSOURI BOTANICAL GARDEN
1889

COVER: Inflorescence of the heartleaf philodendron.

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LITTLE-KNOWN FACTS ON A WELL-KNOWN PLANT

The most popular houseplant ever grown in America is probably the heartleaf philodendron. Its popularity is doubtlessly due to the ability of this species to grow satisfactorily away from the window in almost any position where the plant is needed for its decorative value. With the shift to simplicity in design of the modern home, plants were shifted from the window garden and became a necessary supplement to good interior décor. This change brought about a search for new kinds of plants that would withstand the adverse growing conditions of the home while furnishing the desired decorative effects. It led to the introduction of many kinds of plants previously unfamiliar to the homemaker, such as bromeliads and new aroids[1]—plants whose beauty is their handsome foliage or interesting form rather than their flowers. Of all the plants used for their foliage alone, the aroids provide the greatest number of species for interior use.

There are at least two hundred different kinds of *Philodendron*, native from central Mexico and the West Indies to southermost Brazil and Uruguay. The name of this group of plants comes from two Greek words meaning "tree-loving." It is an appropriate name, since many species of *Philodendron* have elongate stems that climb the tree trunks by means of aerial roots that grow at each joint of the stem. Often these vines grow high into the trees, and have contact with the soil only through their aerial roots which grow down and finally enter the soil. Such roots are very tough, and are an important cordage material in some tropical American regions. In other species, however, the stems are very short, and the plants appear nearly stemless, as in *P. wendlandii*. Such species grow in the forks of trees or upon rocks. Still other kinds develop a trunk and appear tree-like in age, like *P. selloum*.

The common heartleaf philodendron belongs to the group with elongate stems with aerial roots for climbing. For years, this species has been offered on the market under the name of *P.* "cordatum". It is well established that the plant originally described under this name is altogether different from our heartleaf philodendron. The proper name of this latter plant appears to be *P. oxycardium*, although there is some question about it. Until further detailed studies can be carried out, we may speak of this plant as *P. oxycardium*. In its original description the author (A. Schott) made no mention of the material from which he drew his description, but in a publication four years later, he noted that the plant was seen growing in cultivation. It is typical that many of the philodendrons and other plants introduced into the gardens of Europe in the nineteenth century were unknown botanically. And indeed, there are undescribed species growing in our botanical gardens today! It is as if the plantsman always has the lead over the botanist, and despite the long and arduous journies of botanists into the wilds to collect the flora of any particular region, the traveling plantsman will bring back and grow specimens of species unknown to science! Schott found the heartleaf philodendron growing in cultivation before 1854, so he described it as a new species. By 1879, many specimens of this species collected from the wild had accumulated in the botanical museums of Europe, and indicated that *P. oxycardium* occurs natively in the West Indies, Central America, and in northern South America. Subsequent collections show that this species occurs also in Mexico.

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[1] Aroids include philodendron, dieffenbachia, chinese evergreen, the calla (-lily), and the native jack-in-the-pulpit.

In nature, most philodendrons inhabit areas of high rainfall where the soil remains moist even in the dry season. The temperature never falls much below 65°, and constant high atmospheric humidity exists. Philodendrons are most common in lowland rainforest areas where they form a conspicuous element in the forest flora.

According to the plant records of the Missouri Botanical Garden, cuttings of the heartleaf philodendron were among the "plants received from Mr. Fendler from South America[2] about 1869 and later". These records, however, were written in 1898, and possibly were copied from the original notes of Henry Shaw. August Fendler was a first-rate naturalist, and collected plants in southwestern United States as well as in tropical America. He spent four months of 1849 in Panama collecting at and above the mouth of the Río Chagres, an area on the Atlantic side of the present-day Canal Zone. In 1859, Fendler went to Venezuela where he spent four years in the study of the flora and meterological phenomena. He prepared many fine botanical specimens, collected especially in the region around Colonia Tovar, a settlement at 6500 feet altitude where he owned a small farm. He finally returned to the tropics and settled in a suburb of Port-of-Spain, Trinidad, in 1877. where he died in 1885. The specimen of heartleaf philodendron that he sent to Shaw's Garden may well have come from any of these places, but the date "1869 and later" would suggest that it came from Trinidad. When the species growing at this Garden is compared with specimens collected in Venezuela, Trinidad, and Panama, we may have a more accurate idea of the origin of Fendler's plant. Irrespective of its origin, there are plants derived from that introduction still growing luxuriantly on the central wall of the northwest wing of the Floral Display House. They are the best examples of the mature phase of this species known to me. The stems climb about thirty feet to the roof, and the hanging tips often grow down again nearly to the ground. Their diameter equals or exceeds that of a fountain pen. The larger leaves average about 13–14 inches long and about 9 inches wide. Unless heavily pruned, many blossoms are produced in June of each year. Upon first hearing this, many people ask: "You mean philodendrons have flowers?" With rare exceptions, all seed plants have flowers at some time during their life. Otherwise no seeds would be produced, and no new plants would grow. That philodendrons do not flower in our homes signifies lack of proper environmental conditions. But under ideal conditions of growth —conditions similar to those of the forest where the plants grow natively, flowering will occur periodically. A few species produce flowers almost constantly.

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[2] In Bull. Missouri Bot. Gard. 43(7):105. 1955, L. Cutak erroneously reported their origin as Brazil.

Flowering of the heartleaf philodendron appears to be initiated when the days and nights are of nearly equal length, as in the tropical latitudes. At the latitude of St. Louis, this happens about March 21 and again on September 21, but the plants do not respond to the September season. After initiation, many weeks are required for the blossoms to develop, and the first inflorescences open at the end of May. The inflorescence pictured on the cover is typical for philodendrons. It consists of a thick, leaf-like structure (the spathe) that is green or variously colored, wrapped around and enveloping a column covered with many very small flowers (the spadix). The spadix has the pistillate (female) flowers covering the lower part, and the upper part is covered with staminate (male) flowers. Both sorts of flowers are so modified as to scarcely resemble flowers in the usual sense, but they possess the necessary structures for reproduction—namely, pistil and stamens.

The inflorescence of the heartleaf philodendron is about six inches long. The spathe is nearly cylindric, on the outside light green in the lower half, the upper part creamy-yellowish. The inside of the spathe is creamy except near the base where it becomes a rich cherry red. It is interesting that the only color on this elaborate blossom should be hidden deep inside away from the eyes of nature. The spadix is as long as the spathe, and its lower third is covered with female flowers. The upper part is covered with staminate flowers that exude droplets of sticky amber liquid, and it has a mild pungent fragrance, as does the cut tissue.

The flowers are exposed to the elements for a very brief period (about one day) when the upper half of the spathe unrolls to expose the staminate part of the spathe. At this time, the pistillate flowers are probably receptive to pollen, but the exposed male flowers are not yet producing ripe pollen. The spathe soon closes again very tightly around the spadix, after which the pollen is shed. How pollination is accomplished in indeed a puzzle requiring further observation and study. No doubt, there are specific insects involved in the pollination of certain species. Their absence here may explain the lack of seed production in the plants at the botanical garden.

It appears that the Missouri Botanical Garden "has furnished the stock which made the Heartleaf Philodendron the universal houseplant that it is today."[3] Mr. George H. Pring, Superintendent of the Garden, states that "cuttings from this vine were given to Bourdet Floral Company [of St. Louis] for trial as a possible commercial plant some 43 years ago."[3] The small-leaf trailing plants of *P.* "cordatum" so familiar to us in the home are simply juvenile specimens which, if grown again in an ideal environment, would attain the proportions of the mature plants described above. As long as a plant is kept in the home, the low moisture content of the air and the low light intensity, especially of winter, will prevent it from reaching the luxuriant form of which it is capable. But the small-leaf form has become the standard, so as long as your plants have decorative value, you need not worry about the size of the leaves.

—George S. Bunting

(Photo by Kenneth Peck)

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[3] Cutak, L. Bull. Missouri Bot. Gard. 43 (7):105. 1955.

REPORT ON THE NEW GREENHOUSE CONSTRUCTION IN THE MISSOURI BOTANICAL GARDEN

In the beginning of June our large Palm House and the adjoining Economic and Fern Houses were demolished to make room for the new Climatron, a greenhouse of strictly-modern design, which is to take their place this autumn.

The old Palm House and ajoining houses were built in 1913, and had been among the most outstanding features of the Missouri Botanical Garden. The stately greenhouses, with their white columns in front, formed a beautiful background for the water lily pools for any visitors entering the Main Gate. However, in the course of time, the steel structure had deteriorated and was badly rusted in many places. To repair these houses would have been almost prohibitively expensive. Another disadvantage of these old houses was that they allowed the entry of only a small fraction of the total amount of daylight which, especially during winter, slowed the growth of the greenhouse plants to a very large extent.

Any modern greenhouse should be air-conditioned, especially in climates where the summer temperatures get very high, such as in most of the continental United States. The original greenhouse was intended to grow tropical plants in a cool or cold climate, such as England, Holland or Sweden. It was necessary only to heat the houses, which could be done by conventional methods. However, in areas where summer temperatures are very high, the inside of the greenhouse gets still warmer, and the growing conditions for most plants become very poor. Therefore, in climates like St. Louis, we need greenhouses which can be heated during winter and at night, and which can be cooled during day. This can only be done with air-conditioning. Thus, to have really effective greenhouses in St. Louis, they should be air-conditioned.

Air-conditioning actually means the controlling of temperature, by introducing air at the desired temperature. Thus the air must be cooled or heated *before* it is introduced into the greenhouse. For a tropical greenhouse, such as the Climatron will be, it is necessary to cool the air only to a limited degree, which can be done by evaporative cooling. To this end, air is passed through a spray of water. To evaporate water, a large amount of heat must be supplied. As the water evaporates in the air, it removes heat from the air, which is thereby cooled. This cooled air is then pulled through the Climatron by a battery of twenty large fans which distribute the air evenly through the house.

The heating is accomplished in a somewhat similar manner. Instead of having heating coils all through the greenhouse, air is heated in an underground tunnel and is then injected along one side of the Climatron. It is pulled out again on the other side and returned to the heater. In this way a continuous circulation of heated air goes through the house, keeping it at the desired temperature. A special advantage of this method of heating is that it does not, in the least, interfere with the growing of the plants, nor does it produce pockets of hot air near the steam pipes.

The concrete base for the Climatron is at present (August 1st) being poured, and the aluminum superstructure will soon be erected.

Most of the palms of the old Palm House have been saved by very carefully removing the old Palm House structure from around the existing palms, which are now standing free in the Garden. To see a palm grove standing free in the middle of St. Louis is indeed a remarkable sight, and one which will probably never recur in this City.

In the meantime, Mr. Lad Cutak and Mr. Ed Evinger are propagating plants for filling the Climatron after it has been completed. But it will be many years before the planned replicas of tropical forests will be mature, and will completely fill the Climatron.

As if to make up for the temporary scars of the construction program, the water lilies in the pools just beyond the main gate are at their best and are, if possible, more beautiful than ever.

—F. W. Went

PLANTING IN THE CLIMATRON

The Garden is constructing an all new air-conditioned conservatory known as a "Climatron" described elsewhere in this Bulletin. Our Director, Dr. Fritz W. Went, anticipating the day when this would be ready, collected seeds of many of the choice plants he saw growing in the tropical regions of South America while on his trip during the past winter. The Experimental Greenhouse has become a beehive of activity. These seeds, with others received from tropical regions, have been planted and are now growing in profusion, along with many plants and propagating material salvaged from the old palm house. While it is not possible at this time to predict just how many and exactly what kinds of tropical plants we will need for the new "Climatron" we will have on hand a wealth of selected material to give the new display a truly "equatorial" look.

A great majority of visitors will never have the opportunity of visiting and seeing the tropical areas personally. For this reason the space within the great dome will be designed and arranged to simulate three of the general classes of tropical climes: (1) the Panamanian rain forest, (2) the East Indian tropics and (3) an Hawaiian garden. The Panamanian rain forest will be in a warm moist area accomplished by the use of fog mists and a water curtain. Rice paddies, unknown to most Americans, will be the focal point of the East Indian tropical area. Hawaii, for centuries considered a paradise of riotous beauty, will be represented by a garden breath-takingly colorful with such flowers and trees as pink and golden shower trees *(Cassia sp.)*, poincianas *(Delonix regia)* and the tropical hibiscus *(Hibiscus rosa-sinensis)* in its many varieties.

Such economic crops as coffee, bananas, pineapples, tea and cashew nuts will be grown to satisfy curiosity and add to the knowledge of viewers. Mosses, ferns and hundreds of smaller plants will carpet the ground as they do in their native environment.

Tangles of tropical vines, such as philodendrons, monsteras, alamandas, clerodendrons, will climb about in profusion, while orchids, anthuriums, bromeliads and other epiphytes will add their prismatic glory.

The palms will, as they always have, dominate the entire scene. It is hoped that the best of the present trees will survive the ordeal of construction over and around them and return to their former grandeur.

In this age of the atom, jets and flights into outer space, the guiding minds at Missouri Botanical Garden have seen and met the need to bring to the people a haven of beauty, peace and wonder. St. Louisans can well be proud of this new addition to their city.

—EDGAR L. EVINGER

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WHAT'S IN A NAME?

By GEORGE S. BUNTING

Miss Gertrude Stein once wrote: "A rose is a rose is a rose." The essence of this thought is clear, but any true gardener must contest her statement when he starts to plant his garden. Most of us are familiar with the "living fence" rose *(Rosa multiflora)* so widely offered for sale in this country. We know that this rose has no place in the average home garden. Furthermore, we know that the hybrid tea roses offer excellent varieties for the rose garden, while certain species of roses, like *Rosa hugonis*, are lovely shrubs suited for specimen planting.

Imagine trying to landscape our home gardens without knowing the names of at least some plants. There are thousands of species of plants and additional thousands of varieties of these species in cultivation. Our ability to select the correct ones is nowhere better exemplified than in planting our own gardens. To do this we must know something about the many different kinds of plants, and to really know a plant, we must have a name for it. Otherwise, how can we talk about it to others, and read what others have written about its culture and merits

No doubt you like to grow irises in your garden. If you open a catalog to make a selection, you find that there are German bearded irises, Siberian irises, Japanese and Dutch irises, all in many varieties and colors, plus *Iris cristata, I. pumila,* and dozens of others. Many sorts have no common English names, so we must refer to them by their scientific names, which are in Latin.

The Latin name of a plant is suggestive of the name of a person. It consists of two parts corresponding to the last and first name of a person, arranged in that order. Often one of these is familiar to us, as in *Forsythia intermedia, Camellia japonica, Dahlia pinnata, Narcissus pseudonarcissus,* while others like *Pinus, Rosa* and *Juniperus* are familiar in their slightly changed English versions. But many of the Latin names of plants are unfamiliar to us; a name such as *Euonymus Bungeanus* may easily seem to be the name of some ancient citizen of Rome rather than that of some commonly cultivated tree.

Many persons have difficulty with these names, and with good cause. But this is no reason to ignore them. It is better to become familiar with them, understand their origins, the reasons why a plant bears the name it does. Often the name commemorates some person who was in some way connected with botany or the plant concerned; the name of the bird-of-paradise flower, *Strelitzia reginae,* which was described in 1789, honors Queen Charlotte Sophia of the House of Mecklenburg-Strelitz, wife of George III of England. Other names are imaginatively descriptive, like *Iris,* which means "rainbow" in Greek. The cocoanut palm bears the Latin name *Cocos nucifera.* The coconut, when stripped of its husk, suggests the face of a monkey. "Cocos" is the word for "monkey" in Portuguese. Some names are really quite comical when their origins are known. Most of us are familiar with the common weed called the day-flower *(Commelina communis).* The flowers of *Commelina* have two showy blue petals and one inconspicuous one. Linnaeus named this genus for the Dutch brothers Commelin; two of these brothers were botanists of the late seventeenth century, while the third died before accomplishing anything botanical! Still other Latin names are based upon the native name of a plant. The aboriginal American word "batata" forms part of the name for the sweet potato, *Ipomoea batatas,* and is the root of the English word "potato."

The reasons for the usage of the Latin names of plants is easy to explain. There is only one correct Latin name for a plant, and it is standard around the world. Therefore, whether you read French, Russian, or Japanese, the Latin name of a plant always looks the same, and it is always written in the Roman alphabet. It does not change from country to country. You may wish to buy seeds of a fancy Swiss variety of pansies. The catalog may be written in German or French, and the common name of the pansy listed as Stiefmütterchen or pensée, but the proper name for it remains *Viola tricolor* var. *hortensis.* Only the fancy variety names may look strange, and probably many of them will be familiar to the true plantsman.

A second reason for using the Latin

names of plants is for clarity within our own language. We often speak of cedar trees. The word "cedar" is applied to no less than five different plants, all well-known in certain areas or industries. When someone mentions cedar to me, I think first of the red cedar *(Juniperus virginiana)* that grows along the fence rows in the fields in my native Maryland, and which yields that wonderful, scented wood used to make cedar chests and to line closets. But then I stop and wonder: "Maybe the person was talking about the white cedar," a name often applied to *Chamaecyparis thyoides*, as well as to the arbor vitae *(Thuja occidentalis)*. As if the confusion were not already sufficient, the cedar in question could be the true cedar *(Cedrus libani)*, the Cedar of Lebanon, or it might be the Spanish cedar, *Cedrela odorata,* sometimes called the cigar-box cedar. For the sake of clarity, it is often imperative to use the proper (Latin) name of a plant.

It is important to understand why these proper names are in Latin. Why not Greek, or Arabic, or some other difficult tongue? A brief glance at history explains this. After the spread of Christianity, and the fall of the Roman Empire, the monasteries were citadels of academic knowledge and scholarly achievement, and remained so throughout the Dark Ages in Europe until the universities were established. Latin was the language of the Roman Church then even as it is today. The Bible and other writings not originally written in Latin had been translated and laboriously copied in Latin. Books used in the early universities were, therefore, copies of the Latin manuscripts preserved in the monasteries. Hence, Latin was established as the academic language, and since it was the only static one, served as the universal language of the scholars just as it had for the Church. The precedent thus established, Latin persisted as an academic language, and indeed knowledge of it is still a requisite for entrance to the great English university of Oxford, and others in Europe.

About two hundred years ago, a Swedish physician named Carl von Linné originated the idea of giving each species of plant and animal two names. This system is suggestive of our family system of naming, whereby all members of one immediate family have the same surname, and each individual has one or more given (Christian) names. In the case of animals and plants, the name of the genus is equivalent to the surname, and is followed by the name of the species: for example, the proper name of the tiger is *Felis tigris*, and of the lion, *Felis leo;* the American elm is *Ulmus americana*, the Chinese elm, *Ulmus chinensis*, the slippery elm, *Ulmus fulva*.

At the time Linné wrote his great works, (1736–1763), many of the animals and plants of Europe and western Asia were known to science, as well as those of eastern North America and the West Indies, and of coastal South America, Africa, and Australia. The number of known species was already great, and Linné doubtlessly realized that many more species would be encountered as new areas were explored. Before his time, writers had referred to a species by giving the generic name followed by a short description usually of not more than four or five words, for example: *Colocasia hederacea sterilis minor, folio cordato.* This system was clumsy, and very difficult to use when speaking about the various species, especially since these descriptions were in Latin. The binomial system invented by Linné permitted easy mention of any species. Since his native tongue, Swedish, was scarcely known in foreign countries, he wrote his works in Latin, which was still the academic language universally understood in Europe. Even Linné's name was Latinized , which explains why he is known to the world as Linnaeus. The merits of Linné's binomial system were quickly recognized, and it was accepted and followed by other scholars. Its use persisted without interruption until, by international agreement in 1867, the Linnean system became the standard for naming plants. Finally, in 1905, it was agreed internationally that the proper names of plants would be reckoned from the date of publication of Linné's *Species Plantarum* (1753). All plant names published before this date were rejected. Today, all names for newly discovered plants must be Latin in form and published with a description of the species in Latin.

The next time you encounter a Latin plant name, look at it, try to pronounce it. Sooner or later you may meet that name again, or possibly find yourself in a situation where you say: "I wish I could remember that name." Think of your personal pride when your neighbor stops by to watch you plant a new shrub, and in answer to his inevitable question, you can say: "It's a new variety of *Viburnum macrocephalum.*"

HOW NATURE PREPARES FOR WINTER

DR. F. W. WENT *looks behind the scenes of autumn color*

NATURE, in preparing herself for winter, seems to be guilty of enormous waste in the form of great masses of discarded leaves, the dying of the above-ground parts of perennials, and the wholesale death of annual plants. Yet this waste is inevitable since, in most plants, the leaves are so sensitive to adverse winter conditions that they could not survive. However, if we consider the autumnal leaf fall from all angles, it does not turn out to be so bad as it seems at first glance. It might even be said that it is a blessing in disguise.

An annual plant dies less than a year after it germinates, but only after it has finished its life cycle. After having produced seeds, through which the species can continue, it has fulfilled its mission, and even if by some chance the mother plant survived the winter, it would not produce more, or earlier, seed than seedlings germinating next spring. In these annuals, the effort to produce seed is usually so great that not only all food produced in previous months is used up, but also the substance of the stem and leaves is drained from them. Thus, they wither prior to complete seed maturity.

FOOD DRAINAGE

In the agave and yucca, you can observe clear examples of such complete drainage of all living substance from the leaves and trunk. While the plant is still flowering, the leaves start to shrivel, and this shriveling, which indicates progressive emptying of the leaf cells, continues until at seed maturity the rest of the plant is dead. All life has flowed towards the seed. A corn plant may also seem pretty dry after the seed has matured, yet the stalk and leaves still contain a lot of unused food. Dried corn stalks and leaves, therefore, make excellent cattle fodder, especially after silage.

In perennial plants and deciduous trees, the plant seldom (or never) flowers or fruits itself to death. The leaves usually stay on for some time after maturity of the fruit. This is essential for survival of the plant. The fruit production of a cherry, peach, or plum often takes most of the strength from the tree, and the spent storage food has to be replenished. This is accomplished during a few months of intensive photosynthesis after the fruit has become ripe.

FOOD STORAGE

But this is not all. Just prior to the turning of the color in leaves of deciduous trees, they start to mobilize their most important constituents. By the time the leaves drop, they are not much more than empty containers. Attached to the tree they were active factories, provided with all machinery necessary to produce food and other essential chemicals. They also had some storage space, where the manufactured products could be kept until they were transferred to more permanent storage. In autumn, the most valuable machinery, which could not easily be replaced, is moved out of the leaves to branches and trunk. It is then available when new factories have to be installed next spring, when new leaves develop. The most valuable parts are nitrogen-containing compounds (especially proteins), potassium, and phosphorus. These are moved out of the leaves, and this causes the well-known change in color. The green chlorophyll, containing nitrogen, is decomposed, so that only the yellow and orange carotenes are left, and the leaves turn yellow. The sugars and starch are moved out of the leaves. What is left are, mainly, the cellulose of the cell walls, some calcium, the yellow carotenes, and some other materials which are either too hard to move, or which are not very essential.

The dry leaves which drop off in the first autumn winds, after turning color, are really empty shells. This is also indicated by the fact that they decompose very slowly. If they were full of proteins and sugars, such as green leaves are, bacteria would feast upon them, and they would rot rapidly on the moist ground. Fresh leaves, such as grass clippings, put in a compost or leaf mold pile, disintegrate rapidly. But the dead autumn leaves take much longer to decompose. When they are mixed with fresh manure and other materials nutritious to bacteria, they rot more rapidly, but left to themselves, nothing much happens. They have become inert.

The removal of nitrogen, potassium, and phosphorus from older leaves also occurs in annual plants, but only when there is a deficiency of these nutrients in the soil. A plant starving for nitrogen will have its buds and young leaves grow at the expense of the nitrogen in the older leaves, which is moved out. This causes the older leaves to turn yellow and drop off. But in case of a calcium deficiency, the older leaves do not turn yellow and die, because calcium cannot be removed from the older leaves. This is also true in the autumn drop of leaves. They fall off still retaining their full content of calcium.

During the Indian summer in the east, but also to some extent during the fall in the west, leaves of sumac, Virginia creeper, and sweet gum turn a brilliant red or purple. This color is due to the formation of a pigment, anthocyanin, which usually is produced in cells full of sugar. The reddening of the leaves is an indication that their sugar content has gone up. This increase in sugar is usually due to transformation of starch into sugar. The insoluble starch cannot be moved as such. It first has to be changed to sugars which are easily soluble and can thus flow out of the leaves. Formation of sugar from starch occurs rapidly when the temperature drops to near freezing. Therefore, the red colors of the Indian summer flare up after the first cold nights. The cold is the signal, for trees and shrubs, that winter is approaching, warning them to start emptying their leaves before it becomes too cold. They rapidly dissolve their starch, and the resulting high sugar content causes the formation of the red and purple anthocyanins.

COLORS

This effect of cold on red pigment formation explains why the red autumn colors in the Pacific Coast regions are seldom of the intensity encountered in the east. Plants here very seldom are exposed to near-freezing temperatures before they have lost their leaves. Autumn colors here are of the rich golden and yellow types, due to the loss of chlorophyll which normally masks the yellow carotenes.

This also teaches us a lesson about pruning the older leaves of a healthy plant. During the life span of a leaf, there first comes a period when it is growing rapidly and is using much more food than it can make. The second period is the longest. During that time, the leaf's chemical factory is working full blast, and it provides the rest of the plant with food and hormones. The last period sets in as the color begins to change. The factory is dismantled, storerooms are emptied, and all is moved toward the branch. The amount of food and material which becomes available in this way may equal weeks of activity of the leaf in its second period. Therefore, cutting leaves off just because their color is not lush green any more may deprive the plant of huge supplies just ready to be shipped. Usually the leaf drops off by itself at the proper time, through the aid of a very neat mechanism.

Where the leafstalk joins the stem or branch, there exists a layer of cells which are inactive so long as the leaf is active. The activity of the leaf is registered on these cells by the auxin, or plant-growth hormone, which is formed by the leaf. As soon as the flow of auxin stops, this layer of cells becomes active. The cells separate from each other, and in a few days, this layer has become so weak that the leaf, plus leafstalk, breaks off at a slight touch or a breath of wind. As a leaf grows older, it forms less and less auxin. A leaf, after turning yellow, produces no more auxin, and therefore the leaf drops a few days after it has changed color.

—Reprinted from *Sunset*
November, 1945

Review of

VEGETATIONAL HISTORY OF THE OZARK FOREST

by Julian A. Steyermark

Published by University of Missouri Press, Columbia, Mo., 1959

THIS long and scholarly article will be of interest to students of the flora of the Ozarks. However, one should not try to find too much general information, since the article is largely written as a refutation of the views of Beilmann and Brenner, which they published in the Annals of the Missouri Botanical Garden in September, 1951, Pages 261 to 291. Therefore, Steyermark's chapter headed "Evaluation of Recent Works on Ozark Flora", should really read "Critique of the above-mentioned article by Beilmann and Brenner".

Science progresses through collection and intensive study of available facts and a critical interpretation of these facts. Very seldom can a particular view be considered definitive, but each new study is a further penetration, and presumably will correct previous interpretations of the available facts. In this way there is little doubt that Steyermark's book is a definite improvement on the earlier work of Beilmann and Brenner. The latter studied from the situation as existed in the St. Louis and Gray Summit area in the extreme northern part of the Ozarks, and came to the conclusion that most of this forest was of secondary nature. From this they generalized, and concluded that the forests of the Ozarks are of very recent origin.

Steyermark in his article shows this to be an incorrect generalization, and makes it abundantly clear that most of the Ozark region was covered with primary forest. His most interesting chapter is on the present distributional patterns of plants and their development. He makes it clear that a large number of typical Ozark plants are endemic there and must have evolved in that area, especially in the forests, such as: *Callirhoe involucrata, Castanea ozarkensis, Ruellia pedunculata* and *Gallium arkansanum*. Since all of these and many other local species occur in forests, they indicate the age of the forests in the Ozarks.

We might take issue with a statement on which Steyermark bases much of his argument: "The precise and definite relationship apparently existing between a species of restricted distribution and its environment usually indicates that there has been a fine adjustment between that species and its environment, one which has evidently required a long period of time for its adaptation to certain types of soils, temperature extremes, rainfall, and exposure."

We know of a large number of cases, where a species, now restricted to a very small area, has almost unlimited potentialities for growth under a wider range of conditions. Good examples are: the Monterey pine *(Pinus radiata)* occuring in nature in only very limited areas in California, but now very widely planted elsewhere in the world for timber; the dawn redwood *(Metasequoia glypitostroboides)* found growing wild in only a few provinces in China, but formerly distributed over much of the world, and still doing well, when planted in most of Europe and North America.

It also has been shown that many plant species have a most remarkable ability to adjust themselves to widely-varying climatic conditions by developing so-called "ecotypes." Therefore, one must be very careful in concluding that "such micro-climates or edaphic conditions, as they are judged to be, are the key to the diversity of the geographical distributional pattern within the Ozark Region; as they are indeed in other regions of the world, and help to explain many of the variations of the flora."

Most of the rest of Steyermark's study involves historical study and contains extensive records of early land surveys and a lengthy discussion of Beilmann's and Brenner's arguments.

—F. W. Went

* * *

JUNIOR RESEARCH TEAMS OF THE PITZMAN NATURE PROGRAM

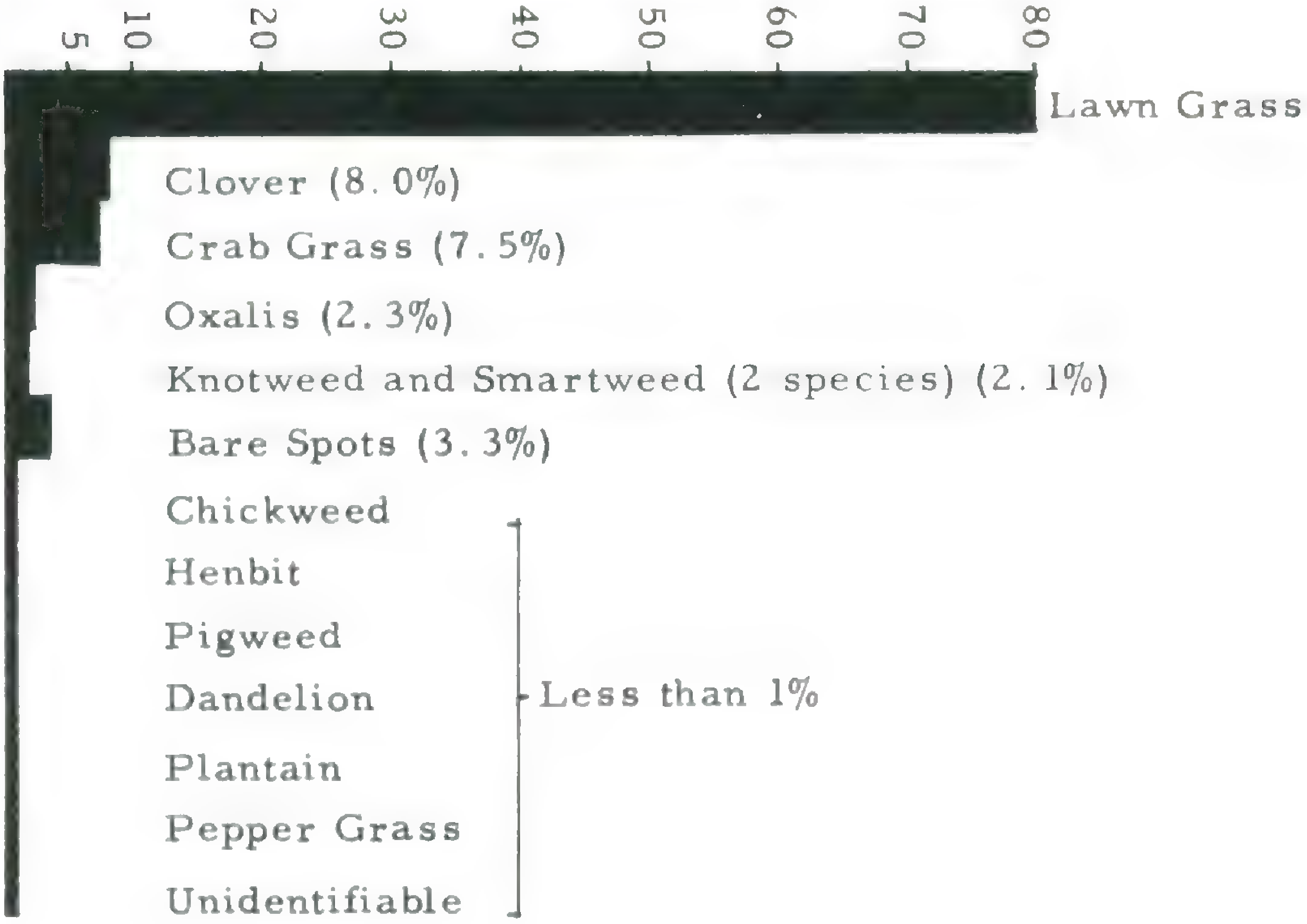
The newly formed Junior Research Teams consisting of senior children (ages 12–15) selected from each session of the Pitzman Nature Program have recently completed two projects of value to the Garden.

The first group, consisting of seven children, made a study of weeds in a lawn area at the Garden. They collected a large number of weeds, identifying, pressing and mounting them, each student making his own collection. An estimate of the percentage of cover of weed and grass species was made by throwing one yard square quadrats at random over the lawn before and after treatment with a weed killer. The results showed that, although many weeds were killed, application of weed killer for broad-leaf plants made during the hot summer months resulted in an increase of crab grass (see graphs). It was concluded that: (1) Crab grass, a fast grower in hot weather, fills in bare spots left by the death of weeds and (2) blue grass and other desirable cool weather lawn grasses are not able to compete with crab grass in hot weather.

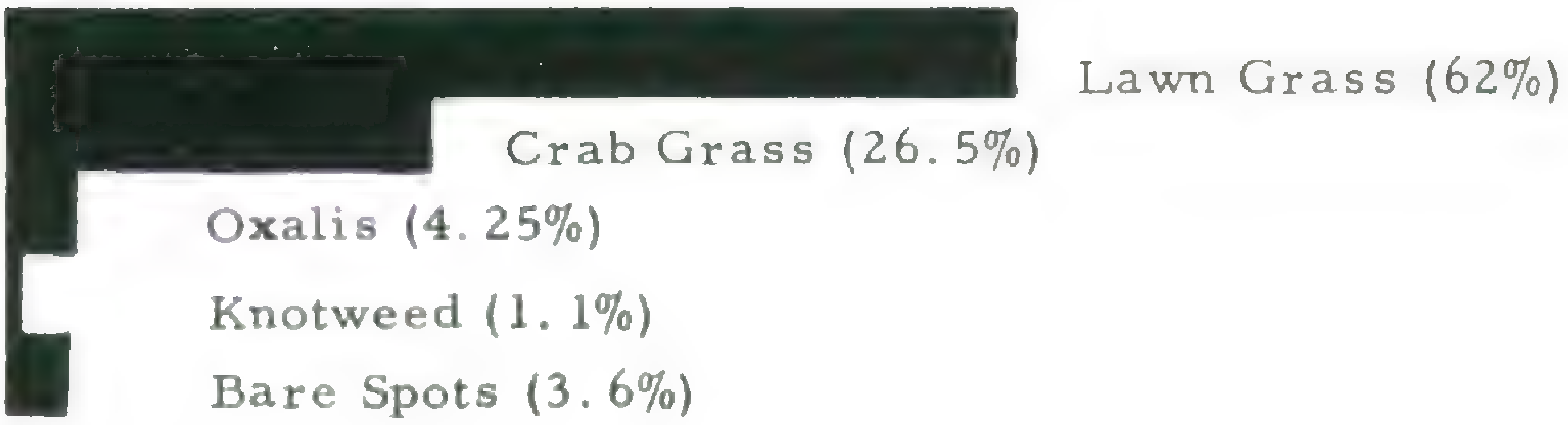
The second team, consisting of five girls, conducted a survey of all the species of oak trees in the Garden. Each of the girls made a collection of oak leaves which she labeled and mounted. The team then plotted the positions of the oak trees area by area on small maps of the Garden. These areas and oak tree positions were then incorporated into a large map of the Garden for display purposes. This renders a complete picture of the 20 kinds of oaks to be found at the Garden.

These two projects were devised to stimulate a deeper interest and understanding of the more scientific aspects of nature study that cannot be accomplished with large groups of children. Displays of the work accomplished by the Junior Research Teams can now be seen in the information office at the Main Gate. These groups were supervised by Beth Andrews, Josephine Davies, and Kenneth Peck.

(See graph page 92)



EARLY JULY - BEFORE TREATMENT
13 Different Species Other Than Lawn Grass



MID AUGUST - AFTER TREATMENT
With 2-4-D. Only 3 species of Weeds Left

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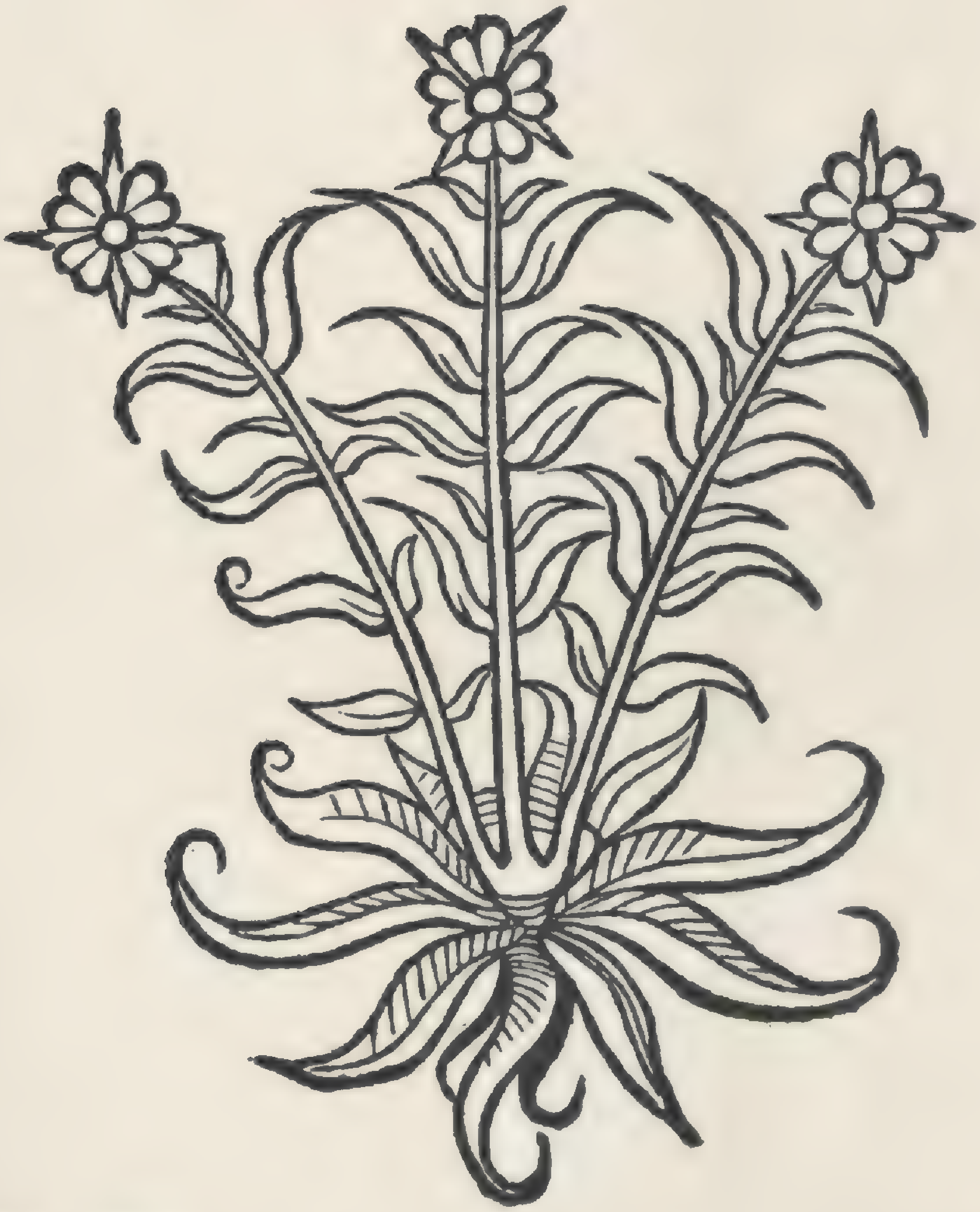
SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at TOWER GROVE, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the TOWER GROVE mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. spring to fall and until six in the winter time though the greenhouses close at five. TOWER GROVE, itself, Mr. Shaw's old country home, is open from one until four, admission twenty-five cents, with special guides. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one most used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southhampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 A. M., but is closed on Saturdays, Sundays, and holidays. The Cleveland Ave. gate, 2121 Tower Grove, is nearly always open, and there is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., adjacent to State Highways 50 and 66. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.

xviij



Nigella **rate**

Nigella calida eſt ꝛ ſicca in tercio· Virtus exiſtit in ſemine· virtutē habet diureticā ex amaritudīe diſſoluendi cōſumēdi ex qualitatibꝫ ſuis· Item emplaſtrū factū ex farina ſeminis nigelle cum ſucco abſinthei circa vmblicū applicatū pueris lūbricos necat. Vngentū cōtra ſcabiem fiat decoctio pulueris nigelle in magna quantitate cū ſulphure in forti aceto ad aliqualē ſpiſſitudinē addito oleo fiat inde vngentū bonū ad ſcabiem

MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME XLVII, NO. 6 NOVEMBER, 1959

CONTENTS

Flower Prints of Five Centuries
Of Drawings Faithfully Made, Etc.
Printing Processes
Catalogue

COVER: NIGELLA. Woodcut from *Latin Herbarius,* 1484.

The exhibition of flower prints has been arranged through the courtesy of the City Art Museum in recognition of the centennial year of the Missouri Botanical Garden.

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FLOWER PRINTS OF FIVE CENTURIES

An Exhibition of Flower Books from the Library of the Missouri Botanical Garden

Few flower prints are found in art collections. In Whitman's *Print Collector's Handbook* as revised by Salaman, not a single such print appears nor is one even mentioned. Leonardo's drawing of a lily and Van Gogh's paintings of sunflowers are art; drawings and paintings to be reproduced as prints, such as Robert's fine delineations, Francis Bauer's exquisite paintings, Redouté's excitingly life like lilies and roses, are usually not considered as art, nor are the prints made from them. But the techniques of the makers of flower prints are the same as those of Dürer, Rembrandt, Hogarth and Daumier; it is their intent to illustrate with life-like reality, rather than to interpret, that tends to exclude their work as art. Still, much of it is very decorative and it has commanded the attention of a large, if special group of admirers.

One seeks in vain for prehistoric drawings or paintings of flowers; plants were static and needed not, as did animals, to be figured to cast a magic spell upon them. Among the ancients plant representations were used as decorative devices and as well in murals and similar paintings portraying harvest and tax records. Shortly before the dawn of the Christian era paintings of plants began to appear in medical works. However, the great days of flower delineation date from the sixteenth century, when the flower print took its rise. This exhibition traces the development of the use of various devices such as the woodcut, the engraved copper plate, the lithographer's stone, in producing flower prints. Since these are usually the work of craftsmen who transferred to the wood, copper or stone what they saw in the artist's original painting, they reflect only at second-hand the development of flower painting itself.

The earliest books containing pictures of plants and, incidentally, of their flowers are manuscripts concerned with their medicinal properties. Among the oldest of these still extant is the great herbal of Dioscorides as rendered in 512 A.D., several hundred years after his death. It contains nearly four hundred paintings of plants, some of which are probably copies of earlier ones by Crateuas (2nd century, B.C.); others are so well drawn as to suggest they were made directly from live plants. But for nearly a thousand years after these drawings were made it is doubtful that in any other manuscript were plants represented from life. These drawings of 512 A.D. and earlier were copied and recopied until they bore little resemblance to the originals.

One of the herbals based on Dioscorides and containing such copies of earlier drawings is the *Herbarium of Pseudo-Apuleius,* a ninth century manuscript. A modern copy of this is shown in (1)*, which shows also a copy of the first printed version of this herbal. Done in 1481, this latter was the earliest illustrated printed book on botany; but its illustrations were not from life. Drawing from live plants was first again used in the *Gart der Gesundheit* of 1485; in (5) we see a 1487 edition of this work in which most of the drawings were again only copies, as are those in the *Ortus sanitatis* (6) of 1511.

It was Brunfels in 1530 who produced the first printed botanical book (7) with all its illustrations made directly from live plants. These were woodcuts made from water-color drawings of Hans Weiditz, a noted illustrator, who was a contemporary of Dürer. Modern copies of these very realistic paintings are seen in (8). Although books containing copies of earlier drawings continued to appear for many years after 1530 (in fact, have never entirely ceased to appear) the spell was broken by Brunfels; flower illustration after 1530 sought to base its laurels on representations of the living plant.

The sixteenth century witnessed the rise and decline of the botanical woodcut in the works of Brunfels (7), Fuchs (9), Mattioli (10), Bock, Dodoens (11, 12), etc. By 1600 the interest in fine detail of plant parts and the availability of etching and engraving techniques prompted the use of copper to replace wood. The development was rapid and the seventeenth century saw the production of many fine books of flower engravings, the work of such artists as Reneaulme (17), de Bry (18) and Robert (21). In general all of this was in black and white, color printing not having been invented and hand coloring not yet the vogue. But with the opening of the eighteenth century a demand for colored prints arose. At first only hand coloring was available and most of the colored prints produced before 1850 were so colored. Some of the best of this is the work of Ehret (29), Jacquin (30), Schwegmen (32) and Bauer (36). Notable exceptions to hand coloring in this period are the single-plate color prints of Kirkall (28) around 1730, and the many examples of Redouté's stipple engraving *à la poupée* (33) in the period 1800–1840.

With the nineteenth century came the lithograph. Colored lithographs were at first hand-colored (37, 38, 40, 41, 42); later they were color-printed with multiple plates (43). But throughout the century hand-colored engraving continued to appear; in (39) we see a choice example. The colored lithograph degenerated as the century wore on and most of the late-century work badly reproduces the originals after which it was made.

The present century has seen the development of new methods of color printing based on photography. Some of the best plates produced by these methods are shown in (50) and (54). But the hand-colored lithographs of Lillian Snelling (53), made as late as 1940, admit little comparison.

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* The numbers refer to the works listed in the catalogue.

In preparing the exhibition I have had substantial assistance from Erna Eisendrath in the selection of material, in planning its organization and in composing the catalogue; Virginia McMahon has contributed many helpful suggestions in the choice of plates and in the improvement of text. To both of these grateful acknowledgment is made.

Of the five books listed in the short bibliography below, that by Wilfrid Blunt was a constant guide to the important, the interesting and the excellent among the hundreds of titles which he had studied. Agnes Arber's *Herbals*, a rich store of knowledge about all of early botany, traces in detail and with many illustrations the history of the botanical woodcut. Claus Nissen's authoritative volume, in addition to being a detailed and complete history of botanical illustration, contains a bibliography of no less than 2387 titles which contain plant illustrations of merit; very possibly these contain more than a quarter million distinct plates. The remaining two books contain extensive analytical bibliographies of the most important eighteenth and ninteenth century flower books, many excellent reproductions of plates from these, and interesting accounts of the artists and their techniques.

— George B. Van Schaack

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OF DRAWINGS FAITHFULLY MADE, Etc.

Illustrations of plants "have been made at different times by diverse types of artists and for diverse purposes: by bold explorers in the cause of science, and by timid spinsters to the glory of God; to record the . . . wildflowers of the . . . homeland, and to make known the gaudy exotics of distant countries; to train the eye of the botanist; to bring knowledge within the reach of the student, or a moment of fleeting pleasure to princes." (Wilfrid Blunt, *The Art of Botanical Illustration,* Collins, London, 1951, p. 262.)

Which of these shall find shelf space in a great botanical library? In a speech delivered at the first annual banquet of the Missouri Botanical Garden, Dr. William Trelease, the director, said, "A great many of the characters of plants cannot be preserved (in a herbarium); and yet a drawing faithfully made at the time when the character is well shown,—for instance, in a transient flower,—may last forever." (1st Annual Report, 1890, p. 130.)

"Drawings faithfully made" shall of course be on our shelves. Botanists call such drawings "icones," a word first used by Otto Brunfels in 1530, in the title of the very book here exhibited. The word has come to have a rather special meaning to botanists who, like most learned groups today, tend to use a private language not easily translated for outsiders. Icones may appear in regional floras, in *de luxe* tomes concerned only with the plants growing in a single garden, in learned treatises on classification, or in nurserymen's catalogues. The covering qualification which allows pictures made for such varied purposes to huddle beneath the inclusive term is that the plant portrayal be of prime importance, and not used merely as elaboration of a printed text. Corollary to this is a meaning implicit in Brunfels' *Herbarum vivae eicones.* His were living portraits of plants, and quite different from the constantly re-used and therefore increasingly less accurate figures printed by his predecessors.

It is almost pedantic to add that accuracy is not lessened by the additional quality of aesthetic satisfaction. Among our icones the two are found in variable proportions, the balance being struck not only on the basis of the purpose for which they were made, but also depending upon the date of publication. The demands of fashion in taste and interest can be followed almost as clearly through this exhibition as the line of development marking mechanical advances in the printing processes!

The earliest illustrations of plants are generally neither very accurate nor very beautiful. They appear in the herbals, early botanical books written in the days when men were most interested in the medical uses they could make of the vegetable world. This was not done on what today would be an acceptable scientific basis, and the descriptions, as well as the illustrations, seem quite naive to our sophisticated ears and eyes. This being true, we must turn again to Dr. Trelease to learn why herbals are important dwellers on the shelves of a botanical library. "No study of the cultivated plants of the present time," he wrote in the 1896 foreword to a catalogue of the Garden's collection of early books, "can be at all complete unless the minute and painstaking records of the herbalists are consulted, for, with so mutable a class of plants as our flowers, vegetables, farm crops and fruits, the tracing of their history under cultivation is no small part of their study. What is asserted of cultivated plants . . . is also true, though to a less degree, of the native plants of temperate regions."

The herbals and volumes containing icones included in this exhibition have been chosen to illustrate, through figures of plants, the development of the printer's art. The great library of the Missouri Botanical Garden contains material for exhibitions equally large, equally interesting and equally beautiful, organized on any number of other premises. It today contains some 150,000 bound volumes and pamphlets, constantly increased by the purchase of newly published books and the addition of older ones previously lacking in the collection. The library receives and keeps complete files of some 700 publications, these being perhaps the source material most usually used by researchers and students. The library's size certainly fulfills the prophecy of Sir William J. Hooker, then director of Kew Gardens, who wrote to Mr. Shaw in 1857 not only that "Very few appendages to a garden of this kind are of more importance for instruction than a library," but also that Mr. Shaw's prospective library would "become like a rolling snowball." (1st Annual Report, 1890, p. 13.)

The library became a reality in 1859 when Mr. Shaw sent his good friend, Dr. George Engelmann, abroad with a commission to assemble the books he thought essential "appendages to a garden." To these were added, in 1882, a fine collection of taxonomic works willed to the library by Dr. Engelmann, himself one of the great botanists of his day. In 1892 the snowball took what was probably its most crescent roll, as in that year Dr. Edward Lewis Sturtevant presented to the Missouri Botanical Garden his fine collection of some 500 pre Linnean works. Most of the herbals in the present exhibition come from his collection, and in a number of the volumes Dr. Sturtevant's plant identifications can be read in his pencilled hand.

Dr. Sturtevant graduated from the Harvard Medical School in 1866, but spent most of his life in agricultural research, at first on his own farm in Massachusetts, later as first director of the New York State Agricultural Experiment Station. In the year in which he presented his library to the Garden he developed the early stages of tuberculosis. On November 5th he wrote Dr. Trelease of his plans to seek recovery in southern California, and of his hopes for the future of his great gift. "I have a strong desire," he penned, "that the library shall serve a purpose. The time will come, I well know it is not immediate, when attention will be given to the problem of the changes that mankind have effected in plants, and the defining of the limits of variation due to various factors of human interference."

Dr. Sturtevant and Dr. Trelease foresaw the same botanical value for his books, and their statements have been amply justified. But these beautiful books, both the early and the late, offer far more than the answers to restricted scholarly problems. They interest us whether or not we know a stamen from a pistil; in them we share with the artist who drew the original figures, with the woodcutter or engraver who made the plates, with the printer who fitted them carefully to his pages, with the owners who have treasured them down through the years, the love of natural beauty which starts scholars on the road to botany, and which ultimately brings these books into a museum of art.

—Erna Eisendrath

PRINTING PROCESSES

A *woodcut* is printed with a block of wood prepared by cutting away one surface to leave just those parts which are to be printed. Ink is applied to the remaining parts of the surface and the paper then pressed against it.

Etchings and *engravings* are printed with a metal plate into the surface of which the design has been cut or eaten. The printing ink is held in the depressions thus formed and is sucked out of them when the paper is pressed onto the plate.

An *etched* plate is prepared by scratching the figure through a wax coating to the surface of the plate. Acid then eats into the exposed metal.

Engraved plates are prepared in various ways: by cutting lines with a burin for *line engraving*, by incising dots for *stipple engraving*, by pushing tiny barbed wheels over the surface for *roulette engraving*. A *mezzotint* plate is prepared by first roughening the whole surface with a rocker and then scraping smooth those places not to be printed. An *aquatint* plate is prepared by coating the plate with a thin mottled deposit of rosin; those parts of the plate not to be printed are then 'stopped out' with varnish and the figure to be printed is scratched through the rosin to the metal. Upon immersing the plate in acid the figure is eaten into the plate; at the same time the acid eats the plate through the tiny holes in the rosin coating, thus making a toned effect. In many engravings two or more of the above methods may be combined, together with some use of etching.

A *lithograph* is printed with a block of limestone prepared by drawing with greasy crayon upon one of its plane surfaces the figure to be printed. After this surface is dampened and blotted, the oily ink used for printing adheres only where the crayon marked the stone.

CATALOGUE

1. APULEIUS BARBARUS. The Herbal of Pseudo-Apuleius from the ninth century manuscript in the Abbey of Monte Cassino [Codex Casinensis 97] together with the first printed edition of Joh. Phil. de Lignamine [Editio princeps Romae 1481] both in facsimile, described and annotated by F. W. T. Hunger. Leyden, Brill, 1935.

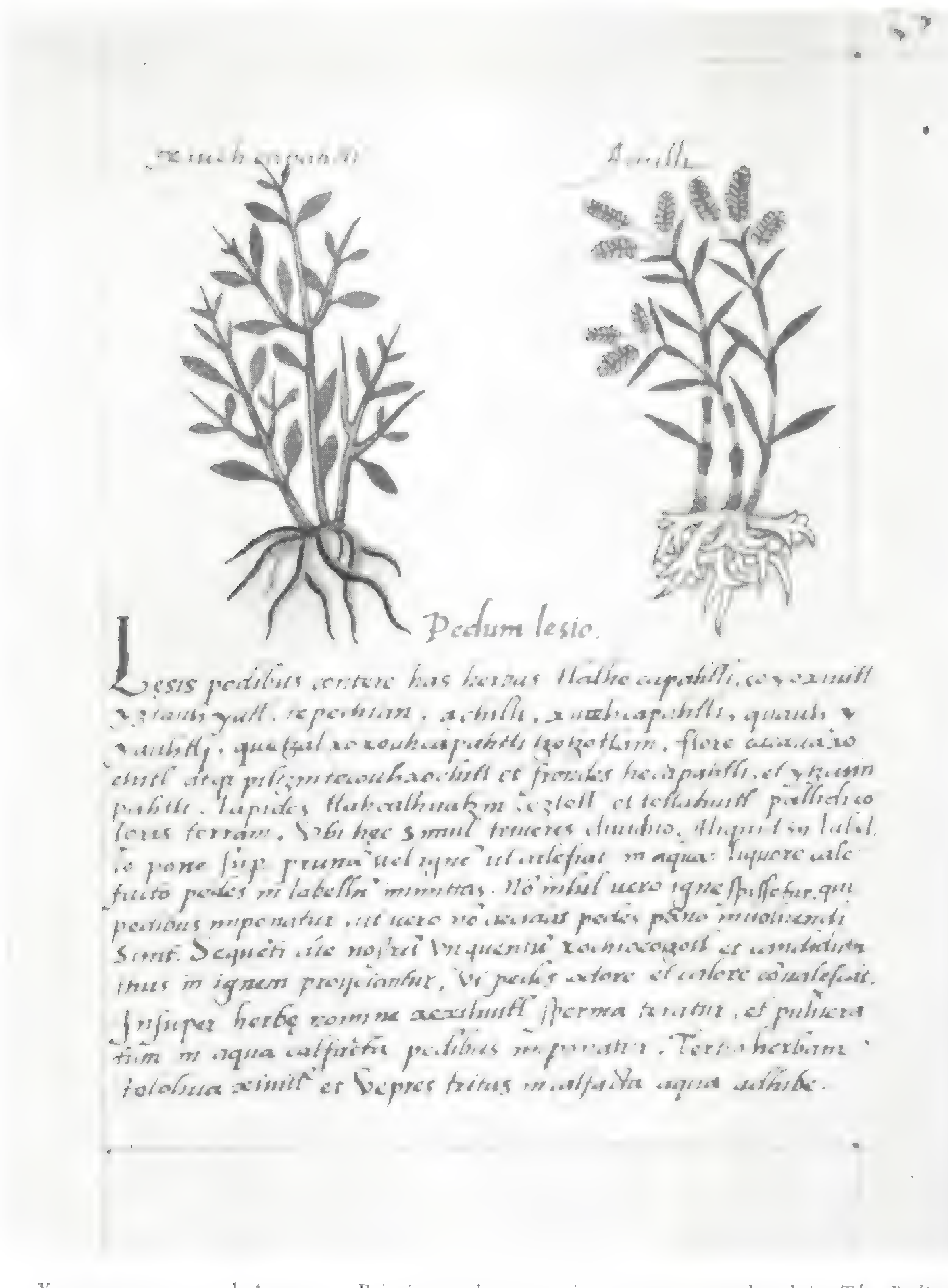
The manuscript (left-hand page) exhibits well the degeneration of plant representation characteristic of the copying which was the rule during the Dark Ages. In the editio princeps (right-hand page) the figures are even further debased. It is clear that the editio princeps is very closely related to the manuscript, but there are enough differences to make us wonder whether it was not made from another, but very similar, manuscript which has perished. In particular the figures in the manuscript are numbered in Roman numerals, those of the editio princeps are unnumbered. The editio princeps is the oldest illustrated printed book on plants.

2. THE BADIANUS MANUSCRIPT (Codex Barberini, Latin 241) Vatican Library. An Aztec herbal of 1552. Introduction, translation and annotations by Emily Walcott Emmart. Baltimore, Johns Hopkins, 1940.

Rediscovered in 1931 in the Vatican Library, this manuscript is presented in a fine facsimile edition. The original, done by two native Aztecs, is considered to be uninfluenced by European examples, although it suggests comparison with the *Herbal of Pseudo-Apuleius* and the *Ortus sanitatis.* Its figures of plants are, however, much more life-like, exhibiting the simplicity of the primitive rather than the degeneration so frequently found in mere copying. These are the earliest known American illustrations of plants, except for stylized representations in Mayan and Aztec inscriptions.

3. LEONARDO DA VINCI. Madonna lily. Copy of a study, ca. 1479.

Although the herbals of the period show astonishing disinterest in accurate representation of plants, this sole surviving example of Leonardo's many youthful flower drawings demonstrates that when drawn from life flowers could be as accurately represented in the 15th century as in any other period.



Xiuhecapahtli Achilli

Pedum lesio.

Lesis pedibus contere has herbas tlalhecapahtli, [illegible] [illegible] yatl, [illegible], achilli, xiuhecapahtli, quauh[illegible], quetzalxoxouhcapahtli tzotzotlani, flore [illegible] atque pilzintecouhxochitl et frondes [illegible]pahtli, et [illegible]pahtli. lapides [illegible] et tetlahuitl [illegible] terram. Vbi hec simul tenueris diutius, aliquid in labello pone sup. prunā vel ignē ut calefiat in aqua: liquore calefacto pedes in labellū immittas. Nō nihil uero igne spissetur qui pedibus imponatur, ut uero nō [illegible] pedes panno inuoluendi sunt. Sequēti die nostrū unguentū xochiocotzotl et candidum thus in ignem proijciantur, ut pedes odore et calore cōualescat. Insuper herbę nomine [illegible] sperma tritum, et puluerisatum in aqua calfactū pedibus imponatur. Tertio herbam tolohua xiuitl et vepres tritas in calfacta aqua adhibe.

Xiuhecapahtli and Achilli. Painting and manuscript page as reproduced in *The Badianus Manuscript*. (Used by courtesy of the Johns Hopkins Press.)

The first plant is unidentified; the second is a *Polygonum*. Both were used in treating *Pedum laesio* (injury of the feet).

4. LATIN HERBARIUS. Mainz, Peter Schöffer, 1484.

This, the oldest illustrated book in the Garden's library, is perhaps unique in America. It is the first issue of a work which was later reprinted many times. It is without author and it was probably copied from a manuscript herbal. Its printer, Peter Schöffer, is considered by some to have been the inventor of printing. Although charming, its illustrations are not very realistic. The figure shows one of the wild carrots.

5. GART DER GESUNDHEIT. Augsburg, Johann Schönsperger, 1487.

In 1485, Peter Schöffer brought out a book known as *German Herbarius*, or *Herbarius zu Teutsch*, or *Gart der Gesundheit*. This German herbal was not a translation of the *Latin Herbarius*, but a new work with large figures of plants, many of them drawn from life. It was copied immediately and well by Johann Schönsperger in Augsburg, but in his third edition in 1487 he reduced the size of the type and of the illustrations, these third-hand renderings showing the usual degeneration incident to copying. Some of the figures, as that of *Aquilegia* on the left, have a life-like quality; most of them are stylized, as in the central figure.

6. ORTUS SANITATIS. Venetijs, Bernardinus Benalius et Joannes de Cereto de Tridino alias Tocuinus, 1511.

Again in Mainz, in 1491, appeared the first edition of an important work, fated to be copied and recopied. The *Ortus sanitatis*, in part at least a Latin translation of the *Gart der Gesundheit*, is more copiously illustrated. This 1511 edition, made in Venice, again shows what happens when figures are copied. On the right is the *Aquilegia*, which, since its appearance in the *Gart der Gesundheit*, has lost much of its realism.

7a. BRUNFELS, Otto. HERBARUM VIVAE EICONES. Strassbourg, Schott, 1530.

7b. BRUNFELS, Otto. HERBARIUM OTH. BRUNFELSII TOMIS TRIBUS Strassbourg, Schott, 1537.

8. RYTZ, Walther. PFLANZENAQUERELLE DES HANS WEIDITZ AUS DEM JAHR 1529. DIE ORIGINALE ZU DEN HOLZSCHNITTEN IM BRUNFELS'SCHEN KRAEUTERBUCH. Bern, Haupt, 1936.

Although in the late 15th century a few plants had been figured directly from life, it was Brunfels who produced the first book entirely illustrated with "living portraits of plants". Not only did he provide that many of the illustrations be at least half life-size, but in Hans Weiditz he chose a well-known artist to make them. Until thirty years ago Weiditz's original water-color drawings were unknown, but in 1930 a number of them were found in Bern; several are shown here in modern color reproductions.

Weiditz was a contemporary of Dürer and, like him, made both paintings and woodcuts. A somewhat lesser light, still his work has at times been confused with Dürer's. His meticulous attention to detail perhaps even surpasses that of Dürer, since he suppresses interpretation in favor of scientific depiction; although the result has the pleasing quality of excellence, it is a tool (a very good one!) rather than an end in itself as are Dürer's paintings.

On the left wall are exhibited two terrestrial orchids, the fall crocus and the fireweed; and on the right, narcissus, viper's bugloss and the common daisy.

9. FUCHS, Leonhart. DE HISTORIA STIRPIUM. Basel, Isingrin, 1542.

The ink was scarcely dry on the first volume (1530) of Brunfels' trail-blazing work when Fuchs produced his sumptuous herbal, of which two copies are shown.

In these fine woodcuts there is already evidence of the tendency to fill out the whole block, forming the plant to fit, which later became extreme in some of Mattioli's work. The device of bending the plant into graceful curves appears again and again in botanical illustration. One may compare here the *Passiflora* in Mutis (cf. 50).

Fuchs' volume marks the peak reached by the woodcut in portraying plants. His figures were copied and recopied with the usual results. But even original work by his successors was inferior. Perhaps the best such work is found in the large plates in some of Mattioli's editions; these are impressive as feats of representing minute detail, but are usually so crowded as to be heavy and without grace.

The plants shown here have a special interest in being two of the native American squashes, which in 1542 had been known to Europeans for less than 50 years. Fuchs was the first to publish figures of them, as also of Indian corn found elsewhere in this work.

10a. MATTIOLI, Pierandrea. COMMENTARII IN SEX LIBROS PEDACII DIOSIORIDIS. Venice, Valgrisius, 1565.

10b. MATTIOLI, Pierandrea. COMENTARII IN SEX LIBROS PEDACII DIOSIORIDIS. Venice, Valgrisius, 1583.

Mattioli's first works in 1555 were illustrated with small woodcuts, but ten years later he started a series of editions with these large and beautifully done plates. Those of woody plants are the most remarkable. But there is a tendency to overload the figures, the plant being provided with so many leaves and so much fruit that an 'all-over' pattern results, the identity of the plant being obscured.

No. 10a, an incomplete copy, was recently obtained by the Garden from a local publisher who had bought it from a truck driver who had found it in an attic!

11. DODOENS, Rembert. POSTERIORUM TRIUM DE STIRPIUM HISTORIA

COMMENTARIORUM IMAGINES AD VIVUM ARTIFICIOSISSIME EXPRESSAE. Antwerp, Loë, 1554.

12. DODOENS, Rembert. PURGANTIUM ALIARUMQUE EO FACIENTIUM, TUM ET RADICUM, CONVOLVULORUM AC DELETERIARUM HERBARUM HISTORIAE LIBRI IIII. Antwerp, Plantin, 1574.

13. CLUSIUS, Carolus. RARIORUM ALIQUOT STIRPIUM. Antwerp, Plantin, 1583.

These three works, in which we see the best that remains of the botanical woodcut, nevertheless trace its decline. In the first are Fuchs' figures used in poor copies. (Cf. 9). In the second, a good woodcut perhaps made from life still lacks the detail which is consistent with artistic quality in a metal engraving. In the last, the belladonna is charmingly done, but with a primitive quality.

14. VAN DER AST, Balthazar. STILL-LIFE: FLOWERS. 1622. (Loaned by the City Art Museum.) Oil on copper.

The flower-piece was typically a product of Holland, the vogue for it extending from about 1550 through two hundred years. Van der Ast was a distinguished painter of its earlier period. As time went on the freedom and extravagance of these works increased, culminating in those of Jan van Huysam, whose glorious paintings of flowers hang in many of the galleries of Europe. The flowers represented are iris, rose, anemone, tulip, carnation, columbine, cyclamen, forget-me-not, etc. Small animals such as flies and snails are also present.

15. CAMERARIUS, Joachim. HORTUS MEDICUS ET PHILOSOPHICUS and ICONES. Frankfurt-am-Main, Feyerabend, 1588.

One of the first books to show plant parts and dissections and one of the last to persist in the use of the woodcut, a medium obviously too coarse to permit the portrayal of exceedingly fine detail.

16. COLUMNA, Fabius. PHYTOBASANOS. Naples, Horatius Salviani, 1592.

The earliest strictly botanical work to be illustrated with intaglio plates, these being done in pure etching.

17. RENEAULME, Paul. SPECIMEN HISTORIAE PLANTARUM. Paris, Beys, 1611.

The etchings in this little volume are as fine as are to be found in a scientific work. They are truly portraits of plants, as sensitive as a Rembrandt.

18. BRY, Johann Theodor de. FLORILEGIUM NOVUM. Oppenheim, 1612–14.

This is one of the best known of the numerous florilegia of the 17th century. These were books, chiefly of pictures of the popular garden flowers, to show people what plants they might have in their gardens. The original etchings from which these beautiful engravings were copied are said to be even finer. Although not confined to bulbous and similar plants, this work is dominated by them, reflecting the low-country nativity of its author.

19. BESLER, Basil. HORTUS EYSTETTENSIS. Curis secundis. Eichstätt, 1640.

Another florilegium, this massive volume was produced to record the flowers growing in the garden of the Bishop of Eichstätt. The illustrations are in the grand manner, often highly decorative, if not always accurate and fine.

20. SWEERTS. Emanuel. FLORILEGIUM AMPLISSIMUM ET SELECTISSIMUM. [Part 1]. Amsterdam, Frederich de Wit, [1612]; and FLORILEGII PARS SECUNDA. Amsterdam, Jo. Jannson, 1654.

The plates of Sweerts' florilegium are in many cases copies of those of de Bry. According to W. Blunt this work, in at least one of its editions, indicated where the plants figured could be purchased and is thus in a sense an early sale catalogue.

21. DODART, Denis. MÉMOIRES POUR SERVIR À L'HISTOIRE DES PLANTES. Paris, Impr. royale, 1676.

The work of Nicolas Robert, who both drew and engraved the plates of this volume, was unsurpassed in the 17th century. The plant shown is the cross vine (*Bignonia capreolata* L.), which may be seen flowering in mid-summer in southern Missouri and from there further south.

22. COMMELIN, Jan. HORTI MEDICI AMSTELODAMENSIS. Volume 1. Amsterdam, Blaeu, 1697.

23. AUBRIET, Claude. HELLEBORUS ORIENTALIS. Plate 45 from Desfontaines, *Choix de plantes*, 1808.

This beautiful stipple engraving was made by Lambert from a water-color drawing of Aubriet drawn nearly a hundred years earlier. Fine as it is, it gives little hint of the original which is well reproduced in Blunt, *The Art of Botanical Illustration*, plate 11. Stipple engraving developed toward the end of the 18th century and was at its height during the first quarter of the 19th century. In its

PASSION FLOWER. Copper engraving from J. T. de Bry, *Florilegium novum*. This plate served as title page for the second addition in 1614.

Augmentatio uberior Florilegij antehac coepti,
iam iterum locupletati, floribus nonnullis
exoticis, viſu jucundis p Ioh. Theodor de Bry.

Fernere Vermehrung des Blumbuchs ſo vor
[illegible] angefangen, und ietz wiederum verbeſsert
mit zuſatz etlicher fremden, lieblichen blumen

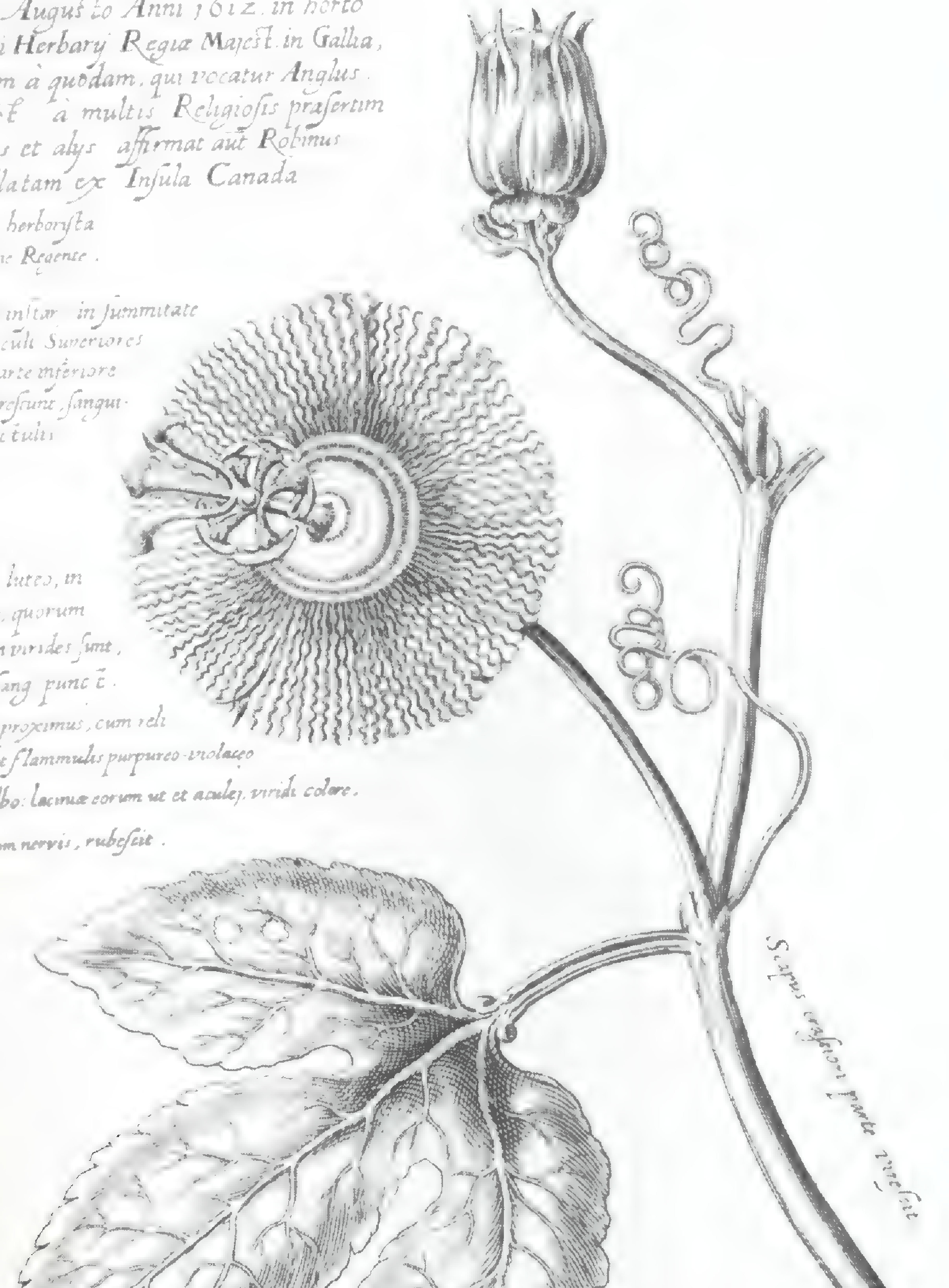
Anno 1614.

Flos Paſsionalis, ſive Grenadille Ex India.

Florüit menſe Auguſto Anni 1612. in horto
Iohannis Robini Herbary Regiæ Majeſt. in Gallia,
vidiq; depictum à quodam, qui vocatur Anglus.
Conſpectus eſt à multis Religioſis præſertim
Capucinis et alys affirmat aut Robinus
ſibi allatam ex Inſula Canada

N Deſcamps herboryſta
de la Roine Regente.

C[illegible] instar in ſummitate
[illegible] cauliculi Superiores
[illegible] umbilico et parte inferiore
[illegible] exalbido-vireſcunt, ſangui-
neis inſperſi puncticulis



Folia 5 externus luteo, in
terius albo colore, quorum
cauliculi in totum virides ſunt,
inſperſi itidem ſang. punct.
Circulus umbilico proximus, cum reli
quis ſtaminulis ut et flammulis purpureo-violaceo
Majora 10. folia albo: laciniæ eorum ut et aculej, viridi colore.
Stria huius alæ, cum nervis, rubeſcit.

pure form it employed no line; in this example lines have been added to shade the leaves.

24. PLUMIER, Charles. PLANTARUM AMERICANARUM. Amsterdam, Auctor & Schouten, 1755–60. Plate 193.

Plumier was not only a botanist, but was prolific in the production of botanical drawings as well. In general these are in outline and many of them are rather pleasing (cf. 51). Others, as the one shown here, are little more than elaborate diagrams, certainly useful, but in a limited fashion, lacking the touch of life that more clever artists could give. Comparing this plate with the Aubriet opposite we are reminded of Dürer's words: "Je genauer man dem Leben und der Natur mit Abnehmen nachkommt, je besser und künstlicher Dein Werk wird." (The more closely one copies life and nature the better and more artistic will be his work.)

25. RHEEDE TOT DRAAKESTEIN, Henricus van. HORTUS INDICUS MALABARICUS. Amsterdam, 1678–1703.

One of the earliest and still today one of the most elaborate and celebrated works on plants of India, this twelve-volume set contains 794 double-page black and white plates from copper engravings. The double page permits life-size figures, and what they may lack in refinement is more than made up in the vitality produced by strong lines boldly drawn. Most of the plates bear the plant name in Latin, Malabaric, Brahman and Arabic.

26a. DILLENIUS, Johann Jakob. HORTUS ELTHAMENSIS. London, 1732.

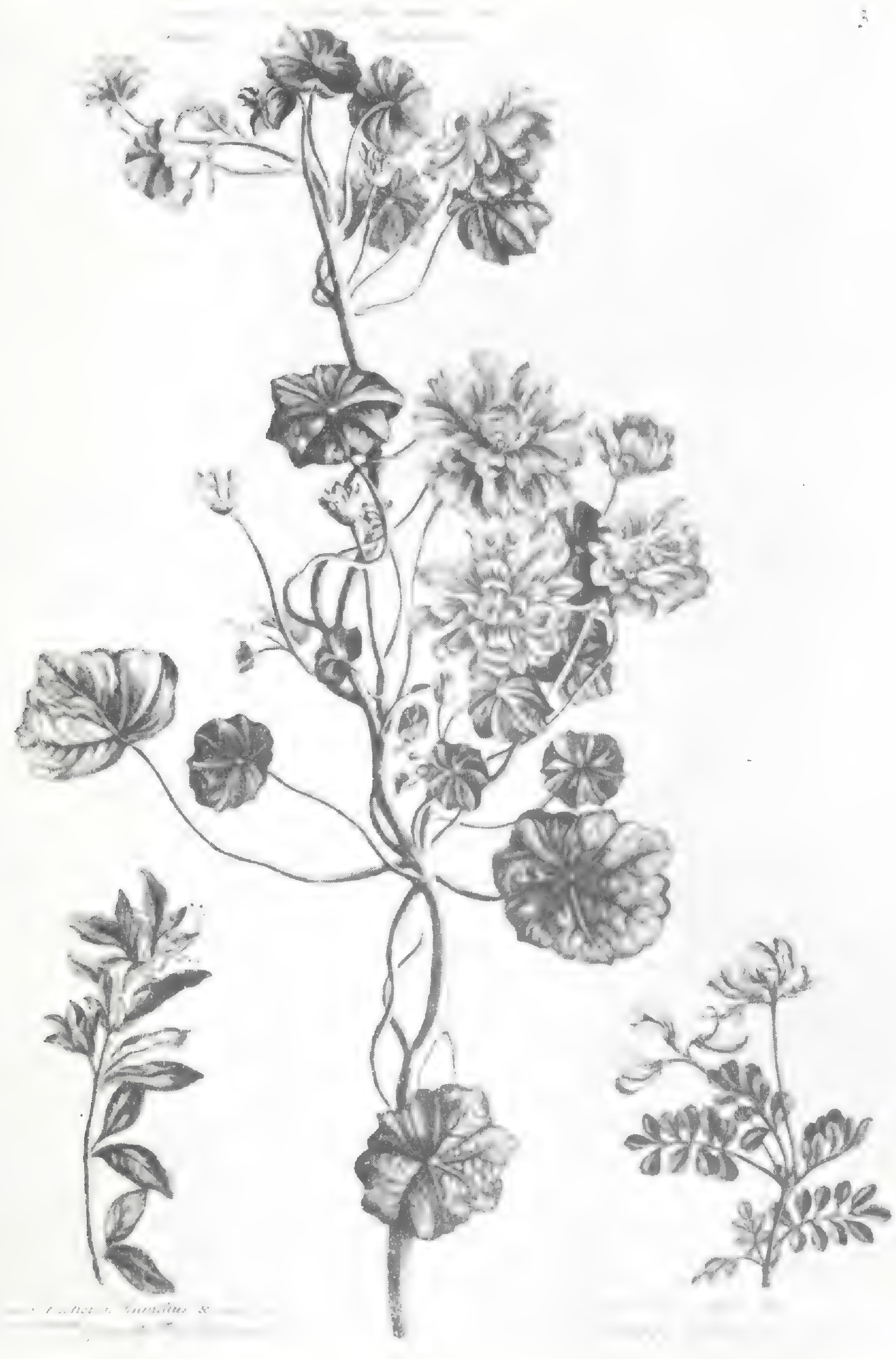
26b. DILLENIUS, Johann Jakob. HORTUS ELTHAMENSIS. Leyden, 1774.

Dillenius, a German, became the first Sherardian Professor at Oxford, having produced this catalog of the plants grown by James Sherard in Eltham. Not only did he make the drawings, more than three hundred of them, but he did the engravings as well, except for plate 324, shown at the right. Noting the fine quality of this single plate we see clearly the difference between professional skill and that of a diligent amateur.

27. BLUNT, W. GEORGE DIONYSIUS EHRET. Twelve reproductions from the original paintings on vellum with an introduction and descriptive text. Guildford, 1953. One plate: The superb lily (*Lilium superbum*).

An account of Ehret is found under Trew (29).

28. SOCIETY OF GARDENERS. CATALOGUS PLANTARUM; A CATALOGUE



DOUBLE NASTURTIUM, ETC. Color mezzotint by Kirkall, after a painting by van Huysum; from Society of Gardeners, *Catalogus Plantarum*.

OF TREES, SHRUBS, PLANTS AND FLOWERS . . . PROPAGATED . . . NEAR LONDON BY A SOCIETY OF GARDENERS. London, 1730.

This work and its immediate predecessor, John Martyn's *Historia Plantarum Rariorum* (1728), mark the beginning of color printing in flower illustration. Many of the plates are mezzotints printed in color, the various colors, usually only two or three, having been all applied at the same time. The paintings were by Jacob van Huysum, whose brother Jan was the more famous Dutch flower painter. The engravings were made by Kirkall, who was experimenting with single plate color printing. The results varied greatly and had usually to be supplemented by hand retouching. In the plate shown the green and brown are printed, the blue and yellow added by hand.

29. TREW, Christopher Jacob. PLANTAE SELECTAE. Nuremberg, 1750–73.

The paintings for this elaborate work are by George Dionysius Ehret, a German, contemporary of Linnaeus, resident most of his life in England. He was one of the most outstanding of all artists of flowers, and very prolific. One of his paintings, reproduced by modern color processes, is shown on the wall at the left; what it became in the hands of the engraver and with hand coloring is seen in the plate shown here.

30. JACQUIN, Nicolaus Joseph. HORTUS BOTANICUS VINDOBONENSIS. Vienna, 1770–76.

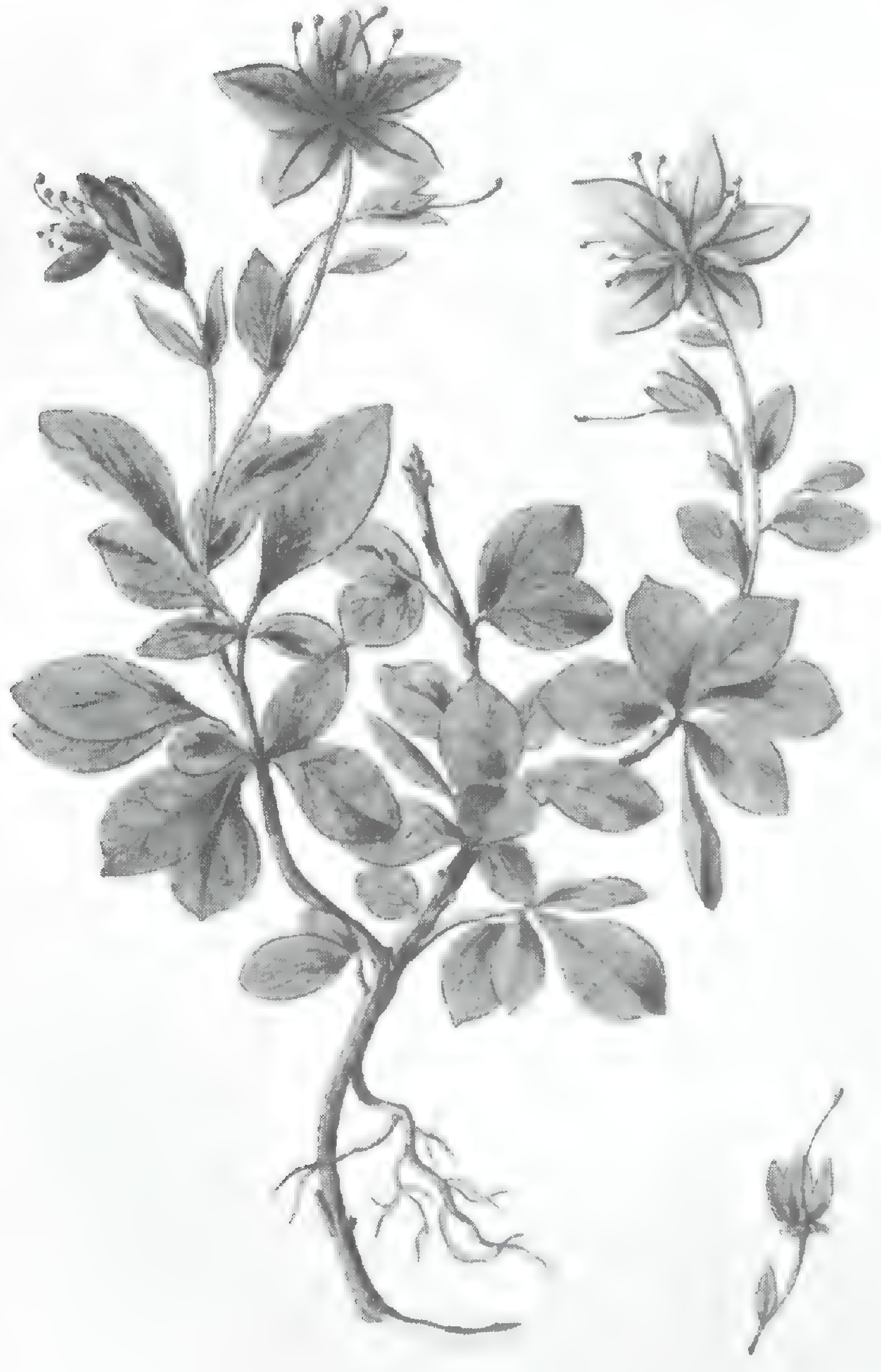
Jacquin was one of the most prolific authors of the late 18th century. In addition to several smaller volumes he produced works comprising fifteen folio volumes of this size or larger, partly illustrated by himself, partly by a large corps of artists whom he assembled in Vienna at the Vienna Botanical Garden. The work shown relates to plants grown in this garden, and was produced under the patronage of Queen Maria Theresa.

31. PALLAS, Petro Simone. FLORA ROSSICA. Petropoli, 1784.

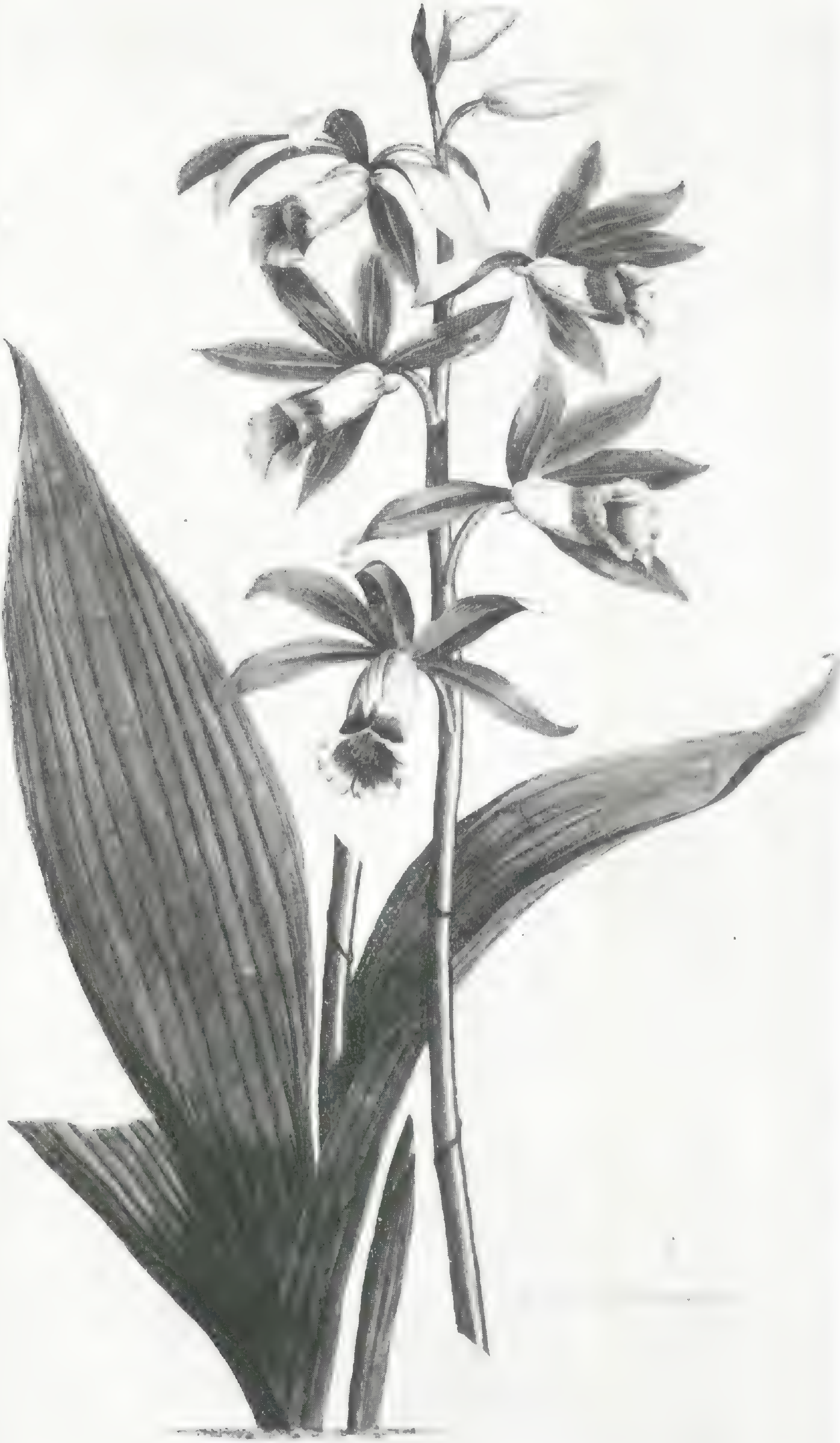
While Jacquin was enjoying Maria Theresa's support, Pallas flourished in Russia under that of Empress Catherine. His travels took him to central Asia and far Siberia, in which latter place he found the gentian shown in the plate.

32. SCHNEEVOOGT, G. Voorhelm. ICONES PLANTARUM RARIORUM; DELINEAVIT ET IN AES INCIDIT H. SCHWEGMAN. Haerlem, 1793.

Schwegman did his own engraving (and coloring?) which may account for the fine quality of this plate. This volume is often considered the Dutch flower


XXXIII.
RHODODENDRON *Kamtſchaticum*
ПЬЯНИШНИКЪ

Kamtchatka Rhododendron. Hand-colored engraving from P. S. Pallas, *Flora rossica*.



book of first rank produced in the 18th century. The plant shown is an orchid of the genus *Phaius,* related to the well-known *Cymbidiums.*

33. REDOUTÉ, Pierre Joseph. LES LILIACÉES. Paris, 1802–16.

Of all flower prints those made from Redouté's paintings have enjoyed the most acclaim. He produced so many fine plates of such elegance that few have not seen examples of his work. The volume exhibited is one of a set of eight devoted to the lilies and their relatives.

The technique used is stipple engraving, printed in color, retouched by hand. The engravers who transferred Redouté's work to metal were extremely skillful; Langlois (shown) was perhaps the best. The printing was done *à la poupée,* that is, the plate was daubed in various colors with small tightly knotted cloths resembling rag dolls (*poupées*) and then the whole thing printed at once; one can imagine the delicacy with which it was necessary to handle the *poupées* that the colors should not get mixed!

This particular set is unusual in having a proof print in black for each color print. The reason for this is not clear, but it affords a fine opportunity to study the effect of the color.

34. L'HERITIER DE BRUTELLE, Charles Louis. STIRPES NOVAE, AUT MINUS COGNITAE. Paris, 1784–85.

It is Redouté's work reproduced *à la poupée* (cf. 33) in *Les Roses, Les Liliacées,* etc., in the early 19th century upon which his popularity seems to be based. But he produced many works which appeared then and earlier in uncolored engravings, both line and stipple. Of his colored line engravings the work shown here was done before he had gone to England to study stipple engraving. The engraved lines were printed in various colored inks,—green for the leaves, brown for the stems, etc., all of the colors being printed at the same time. Within the outlines thus produced the print was then colored by hand. Comparison of the result with that produced by the later method seen in No. 33 suggests that the latter was a logical development of the former. Redouté was striving for continuous toning, possible in his later stipple engravings, but only suggested here where the darker lines tend to destroy the continuity. He succeeded in his quest, but did his success not eliminate a certain artistic quality which these earlier prints have?

35. THORNTON, Robert John. NEW ILLUSTRATION OF THE SEXUAL SYSTEM OF CAROLUS LINNAEUS. London, 1799–1807.

LIMODORUM TANKERVILLIAE. Hand-colored engraving by H. Schwegman; from G. V. Schneevoogt, *Icones plantarum rariorum.*

One of the heaviest volumes in all of botany and one of the least important. Its Part Three: *The Temple of Flora*, however, has enjoyed a popularity second to none because of its elaborately produced and often decorative plates. The equally elaborate text, not often very informative, is replete with the romantic poetry about flowers which was so popular around 1800.

The plates were engraved by various processes, partly printed in color, partly finished by hand, frequently changed from time to time as the publication proceeded. No two copies of the work contain the same selection of plates. Apparently as orders came in for a copy or two the author had bound up whatever happened to be on hand. As it was, the venture ruined him financially for life; with such expensive plates he couldn't always have available a complete set.

The plate shows the night-blooming cereus of Jamaica, content in an English churchyard! As if foreshadowing the multiplicity of credits attributed in a modern film production, the flower was the work of Reinagle, while the moonlight was supplied by Pether.

36. LAMBERT, Aylmer Bourke. A DESCRIPTION OF THE GENUS PINUS. London, 1803.

Most of the illustrations in this work were drawn by Ferdinand Bauer who was most fortunate in his engravers. These plates were the particular joy of the German poet, Goethe, who praised them many times and who said that in them "Nature is visible, Art concealed." This copy is one of the few to be colored, probably by William Hooker, a pupil of Francis Bauer, brother of Ferdinand.

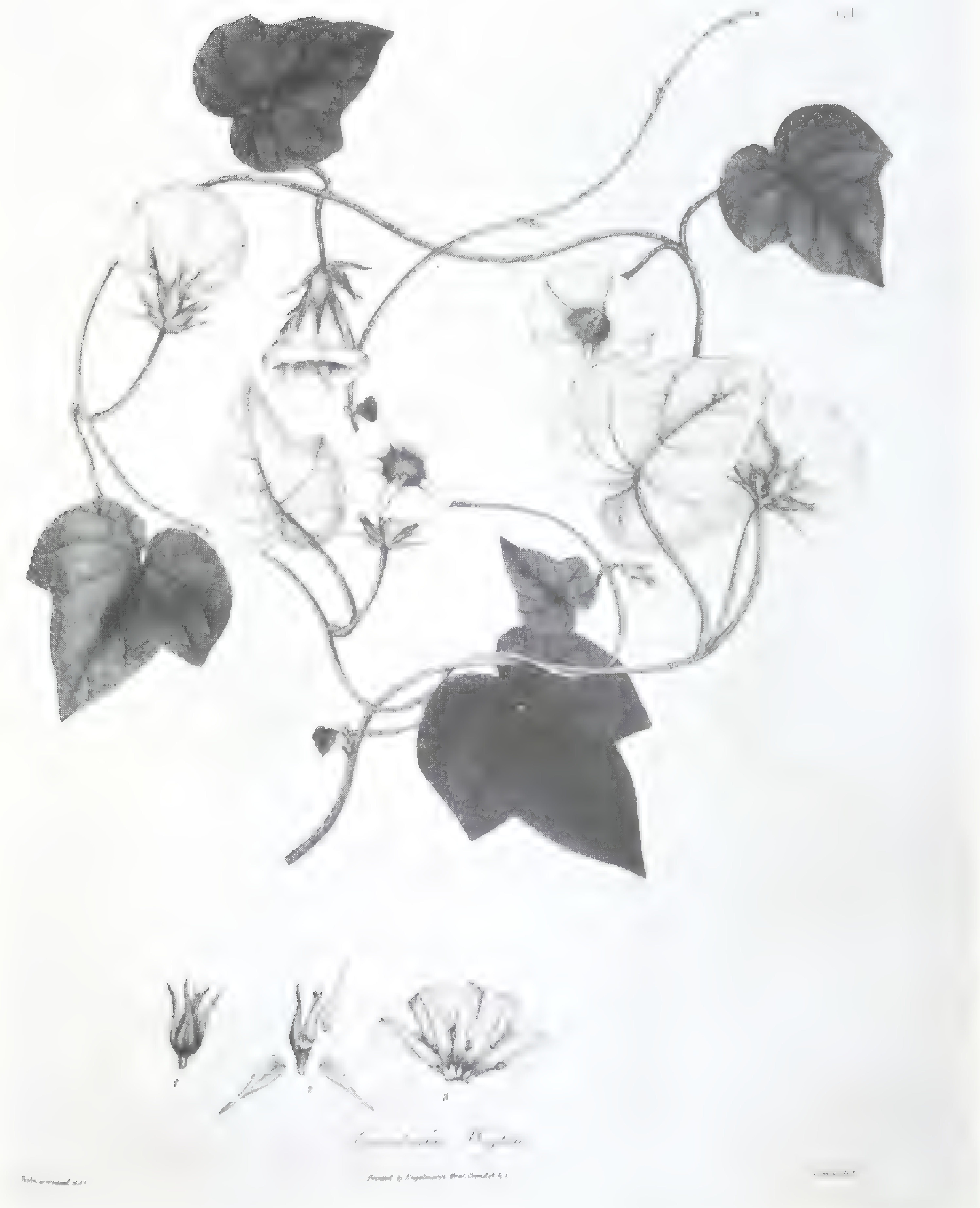
The plate shows a larch, not now considered to belong to the same genus as the pines.

37. [KER, C. H. B.] ICONES PICTAE INDO-ASIATICAE PLANTARUM EXCERPTAE E CODICIBUS DOM: CATTLEY. London, 1818.

This slender volume contains some very charmingly hand-colored lithographs and etchings. It is apparently quite rare, being a sort of incomplete pre-issue of a fuller work appearing in 1820. The library at Kew is said to have a more complete copy with the same title page and an advertisement signed by W. Cattley (after whom the orchid *Cattleya* is named), stating that of the thirty figures "twenty-four were printed on stone and were drawn by Mr. H. B. Ker."

38. WALLICH, Nathaniel. PLANTAE ASIATICAE RARIORES. London, 1830–32.

By no means all of the flower paintings and drawings reproduced in Europe were made by European artists. For Wallich's large three volume work dealing with rare Asian plants the original drawings were made by a corps of native artists



Morning-glory. Hand-colored lithograph by Gauci, after a painting by Vishnupersaud; from N. Wallich, *Plantarum asiaticae rariores.*

in India, of whom Vishnupersaud was foremost. Gauci's fine lithographs of these drawings were colored by hand.

39. BURY, Mrs. Edward. A Selection of Hexandrian Plants. London, 1831-34.

Mrs. Bury, a self-styled amateur, was most fortunate in her engraver, R. Havell, whose fame rests on his work in producing the Audubon bird prints. The plates in this volume are aquatints, partly printed in color, but finished by hand, the hand of R. Havell himself. They are certainly among the most decorative of all flower prints.

40. HOOKER, Joseph Dalton. The Rhododendrons of Sikkim-Himalaya. London, 1849.

The fine hand-colored lithographs in this work are by the distinguished Walter Hood Fitch, who produced a steady stream of botanical drawings for fifty years. These particular ones are from Hooker's own sketches made on a botanical trip to India.

41. BATEMAN, James. The Orchidaceae of Mexico and Guatemala. London, 1837-43.

This is the largest and heaviest botanical work ever produced. Its handsome hand-colored lithographs were made from paintings by Mrs. Withers, Miss Drake and others, by Gauci, who had done those of Wallich (38).

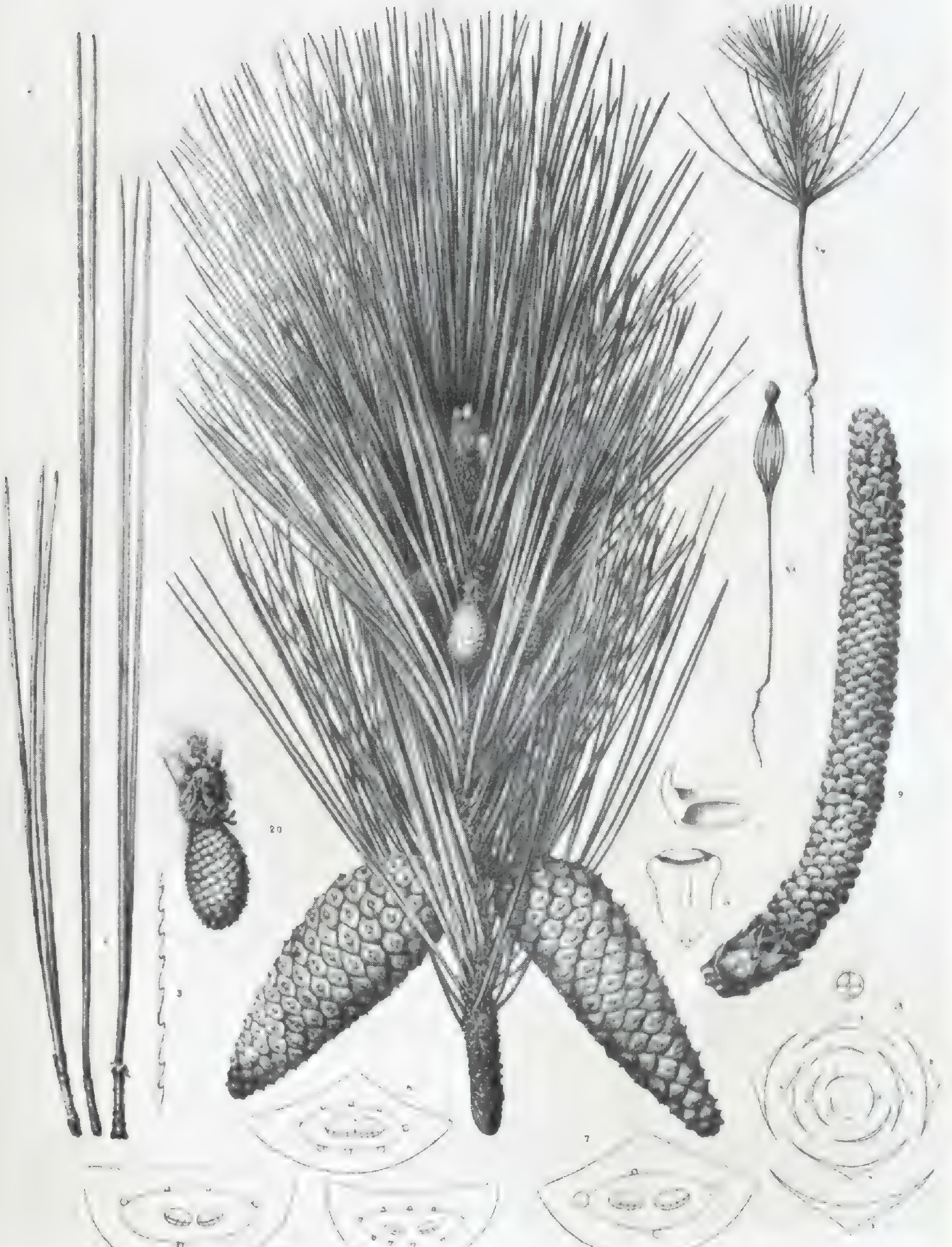
42. MARTIUS, Karl Friedrich Philipp von. Historia naturalis palmarum. Munich, Leipzig, 1823-50.

A monumental three-volume work on palms with 240 hand-colored lithographs.

43. ALLEN, John Fisk. Victoria regia, or the great water lily of America. Boston, Dutton and Wentworth. 1854. (Single plate only).

Sumptuously done colored flower prints appeared rarely in this country. The one shown is a chromo-lithograph, very decorative, if a little stiff. According to the title page the illustrations for this work were "by William Sharp, from specimens grown at Salem, Massachusetts, U.S.A." Three years earlier in England Sir Wm. Jackson Hooker brought out another sumptuous folio volume with illustrations of *Victoria regia* by W. H. Fitch. Comparison of the two works makes one wonder if identical groupings of plants grew in England and in Salem. Copying plant illustrations will never die!

Pinus Elliottii. Lithograph *by P. Roetter;* from G. Engelmann, *Revision of the genus Pinus, and a description of Pinus Elliottii.*



PINUS ELLIOTTII. Engelm

P. Roetter from nat. on stone

Print by A. Meisel.

Victoria Regia, native of the marshes of the upper Amazon, may be seen any summer blossoming in the lily pools at the Missouri Botanical Garden.

44. ENGELMANN, George. Revision of the genus Pinus, and a description of Pinus Elliottii. St. Louis, 1880.

This publication has special interest as being purely a product of St. Louis. Dr. George Engelmann, a German physician, settled here before 1840 and for over forty years thereafter was not only the pre-eminent scientist of the region, but one of the three outstanding botanists of the whole country. It was he who counselled Henry Shaw to make of the Missouri Botanical Garden a scientific institution rather than merely a show place. He was one of the founders of the St. Louis Academy of Science, in the Transactions of which the work exhibited first appeared. The drawings were made directly on stone by a local artist, P. Roetter, whose work is certainly of excellent quality. For another very extensive publication of Engelmann, *The Cactaceae of the Boundary*, Roetter drew a series of 76 excellent figures which Engelmann took to Paris to be engraved under the direction of the same Picart who did many of the plates for Sargent's great *Silva of North America* (45).

45. SARGENT, Charles Sprague. The Silva of North America. A description of the trees which grow naturally in North America exclusive of Mexico. Boston and New York, 1891-1902.

This fourteen-volume work contains 740 uncolored plates drawn by C. E. Faxon who, in Sargent's words, "united accuracy with graceful composition and softness of outline". Faxon was an American, but his drawings were engraved in Paris. These plates show well how roulette engraving gives a crispness to the plate, but at the same time leaves the outline and shading soft rather than hard.

46. CURTIS, William. The Botanical Magazine. London, 1787– .

This great serial has been published continuously for over one hundred seventy years. Initially a private enterprise of William Curtis, it is now a publication of the Royal Horticultural Society. In all it contains nearly ten thousand colored drawings of plants, most of them introduced into cultivation in England. Quite remarkable is the fact that until 1948 all of the plates were colored by hand. The seven plates show the various ways in which different artists have treated the peony; they range in date from 1812 to 1952.

47. LINNAEUS, Carolus. Hortus Cliffortianus. Amsterdam, 1737.

Of all Linnaeus' works this is the only one elaborately produced, having been supported by a rich banker, George Clifford of Harlem, whose botanical garden is the subject of the book. It was illustrated by the then young George Ehret and J. Wandelaar. The latter not only contributed this fascinating frontispiece, but supplied a poem to explain it. According to this, Mother Earth, with the support of Clifford's enterprise and the pen of Linnaeus, here receives and propagates the plants of distant lands, and now through all seasons may Europe enjoy the noblest plants, fruits and flowers of Asia, Africa and America.

48. SIBTHORP, John S. FLORA GRAECA. London, 1806-40. (1845-56 reprint).

Each of the ten volumes of this monumental work on the plants of the eastern Mediterranean has a frontispiece with a different scene from that region. Each of these is further decorated with flowers from the groups of plants treated in the volume. Volume 8 (exhibited) is devoted to plants of the pea family.

49. BLUME, Carl Ludwig. COLLECTION DES ORCHIDÉES LES PLUS REMARQUABLES DE L'ARCHIPEL INDIEN ET DU JAPON. Amsterdam, 1858.

The frontispiece, elaborately decorated with orchids, is a lithograph partly printed in color.

50. FLORA DE LA REAL EXPEDICION BOTANICA DEL NUEVO REINO DE GRANADA. Madrid, 1954– .

A fine example of modern color reproduction, published in the grand manner. The paintings, however, date from the late 18th century, having been made under the direction of Don José Celestino Mutis, who led an extended botanical expedition to what is now Colombia. The plate shown is a rather extreme example of the tendency of all Mutis' artists to "arrange" the plants in what they considered pleasing designs.

The exhibits at left and right (51 and 52) show other treatments of the same plant, a passion flower.

51. PLUMIER, Charles. DESCRIPTION DES PLANTES DE L'AMERIQUE. Paris, 1693.

52. JACQUIN, Nicolaus Joseph. HORTUS BOTANICUS VINDOBONENSIS. Vienna, 1770-76.

53. GROVE, Arthur and A. D. COTTON. A SUPPLEMENT TO ELWES' MONOGRAPH OF THE GENUS LILIUM. London, 1934-40.

These fine plates, which are lithographs by Lillian Snelling, have been most skillfully colored. In excellence they are doubtfully surpassed as botanical color prints by anything done in the last hundred years.

54. DESCOLE, Horatius R., ed. GENERA ET SPECIES PLANTARUM ARGENTINARUM. Buenos Aires, 1943- .

The day of the oversize volume in botanical publishing is not over; less than twenty years ago Argentina embarked upon the production of this sumptuous 'flora' in the grand manner, to be illustrated with elaborate drawings, many of them colored. Five volumes have appeared. The color-plate work varies in quality, —at its best it uses our modern machine methods to as good advantage as the older methods were being used a hundred years or more ago.

55. IINUMA, Yokusai. SOMOKU-DZUSETSU. Rev. ed. Ogaki, 1874.

These effective Japanese woodcuts show the convention of representing the upper surface of the leaf black, the under, white. Color is little used, except occasionally for the flower or a part of it.

56. KOCH, Rudolf. DAS BLUMENBUCH. Zeichnungen von Rudolf Koch in Holz geschnitten von Fritz Kredel. Darmstadt, 1929-30. (Loaned by Mr. Emil de Leuw).

A modern German florilegium with woodcuts reminiscent of those of four hundred years earlier. Privately printed for a German book society.

57. VELICK, Bernadette. INK DRAWING. 1959.

This original ink drawing was made at the Missouri Botanical Garden by Bernadette Velick of St. Louis. Beside it is the commercially produced engraving to be used as an illustration in an article on plants of Panama which will appear next spring in the Garden's Annals.

58. NANNFELDT, John Axel, and G. Einar DU RIETZ. VILDA VAXTER I NORDEN. Stockholm, 1952.

As so much of the handwork in this exhibition manifests, it is "understanding" and its reflection which the artist brings to the making of a flower print. It is doubtful that any camera can equal this in effect, but just as doubtfully could any eye and hand depict so well the sheer complexity of plant life as we see it here in these fine color-photo reproductions.

GENERAL INDEX

Agavaceae, 71
Aizoaceae, 72
Alexander, Mrs. Campbell, 27
Allen, John Fisk, 114
Anderson, Dr. Edgar, 32, 34, 43-44
Andrews, Dean Henry N., 32
Andrews, Mary Beth, 47, 91
Apuleius Barbarus, 99
Aquatint, 98
Arboretum, 39
Asclepiadaceae, 69
Attendance, 38
Aubriet, Claude, 104
Aztec Herbal, 99, 100

Badianus Manuscript, 99, 100
Barbre, Clarence, 34
Bateman, James, 114
Bauer, Ferdinand, 112
Besler, Basil, 104
Blume, Carl Ludwig, 117
Blunt, W., 106
Book Reviews: Mariano Ospina Hernandez's "Colombian Orchids," 47; Julian A. Steyermark's "Vegetational History of the Ozark Forest," 89
Bowman, Helen, 47
Brunfels, Otto, 101
Bry, Johann Theodor de, 103, 105
Bunting, George S., 77, 83
Bury, Mrs. Edward, 114

Cactaceae, 66
Camerarius, Joachim, 103
Cannas for St. Louis, Old-fashioned, 42
Catalogue, 99
Cattleyas and their allies, 3
Climatron. Report on construction, 81; Planting, 82
Clusius, Carolus, 103
Columna, Fabius, 103
Commelin, Jan, 104
Cotton, A. D., 117
Crassulaceae, 73
Crateuas, 93
Curtis, William, 116
Cutak, Ladislaus, 49
Cutler, Hugh C., 25
Cymbidiums, 13
Cypripediums, 12

Davies, Josephine, 26, 47, 91
Descole, Horatius R., 118
Desertariums and dish gardens, 57
Dillenius, Johann Jakob, 106
Dioscorides, 93
Dish gardens and desertariums, 57
Dodart, Denis, 104
Dodens, Rembert, 102, 103
Du Rietz, G. Einar, 118

Education programs, 34, 44; Summer nature classes, 45; Tours, 44; Saturday activities, 45; Pitzman nature program summer 1959, 46; Junior research teams, 91; Chart, 92
Ehret, George Dionysius, 106, 108, 117
Eisendrath, Erna, 98
Engelmann, Dr. George, 97, 115, 116
Engravings, 98
Etchings, 98
Euphorbiaceae, 68
Evinger, Edgar L., 35, 82
Exhibition and flower shows, 35; exhibition of flower books, 93

Faxon, C. E., 116
Fitch, W. H., 114
Flora de la real expedición del Nuevo Reino de Granada, 117
Flower Prints of Five Centuries, 93
Flower sermon, 36
Flower shows, 35
Fuchs, Leonhart, 102

Gart der Gesundheit, 101
Gauci, M., 114
Gillespie, Robert J., 1, 34; Review of Mariano Ospina Hernandez's "Colombian Orchids," 47
Greenhouses, 35
Grove, Arthur, 117

Hath, Earl H., 47
Hath, Mrs. Earl H., 27, 39, 47
Havell, R., 114
Herbarium, 30
Herbarius zu Teutsch, 101
L'Héritier de Brutelle, Charles Louis, 111
Hooker, Joseph Dalton, 114
Hooker, Sr. William J., 97, 114
Hooker, William, 112

Iinuma, Yokusai, 118
Information Center, 38
Ivy and Plumbago, 43

Jacquin, Nicolaus Joseph, 108, 117

Ker, C. H. B., 112
Kirkall, 108
Knapp, Mrs. Hazel L., 27
Koch, Rudolf, 118

Lambert, Aylmer Bourke, 112
Lambert, J. B., 23
Latin herbarius, cover No. 6, 101
Leonardo da Vinci, 99
Library, 33
Liliaceae, 70
Linnaeus, Carolus, 86, 116
Lithograph, 98
Little-known facts on a well-known plant, 77

Maintenance, 37
Martius, Karl Friederich Philipp von, 114
Martyn, John K., 108
Mattioli, Pierandrea, 102
McCready, Frank, 39
Mezzotint, 98
Missouri Botanical Garden in 1958, 25
Nannfeldt, John Axel, 118
National Council of State Garden Clubs Headquarters, 39
Nature prepares for winter, 87
Nickerson, Dr. Norton H., 26, 34
Niedringhaus, Carolyn Lee, 39
Nigella, cover November Bulletin

O'Byrne, Mrs. Stuart, 47
O'Bryne, Stuart, 47
Odontoglossums, 15
Of Drawings Faithfully Made, etc., 96
Orchid culture, 1; diseases, 19; culture chart, 23; department, 34
Ortus sanitatis, 101

Pallas, Petro Simone, 108, 109
Peck, Kenneth O., 44, 47, 91
Pether, Abraham, 112
Philodendron, cover September Bulletin; 77, 80
Picart, Eugene, 116
Pitzman nature program summer 1959, 46; Junior research teams, 91; chart, 92
Plants in relation to climate, 48
Plant introductions, 35
Plumbago and Ivy, 43
Plumier, Charles, 106, 117
Printing Processes, 98

Redouté, Pierre Joseph, 111
Reinagle, Philipp, 112
Reneaulme, Paul, 103
Rheede tot Draakestein, Henricus van, 106
Robert, Nicolas, 104
Roetter, P., 116
Rouk, Hugh, 32
Rouk, Mrs. Hazel, 32
Rytz, Walther, 101

Sargent, Charles Sprague, 116
Saturday activities, 45
Schneevoogt, G. Voorhelm, 108
Schöffer, Peter, 101
Schönsperger, Johann, 101
Schwegman, H., 108; facing 111
Sharp, William, 114
Shaw, Henry, 28
Shaw House, 39
Sibthorp, John S., 117
Snelling, Lillian, 117
Society of Gardeners, 106, 107
Start, Clarissa, 41
Stern, Jeane, 47
Sturtevant, Dr. Edward Lewis, 97
Succulents, 49; culture and care, 51; in the garden, 53; hardy, 54; as house plants, 56; making desertariums and dish gardens, 57; propagation, 59; cactaceae, 66; Euphorbiaceae, 68; Asclepiadaceae, 69; Liliaceae, 70; Agavaceae, 71; Aizoaceae, 72; Crassulaceae, 73; miscellaneous, 75
Summer nature classes, 45
Sweerts, Emanuel, 104
Symposium, Systematics, 26

Thornton, Robert John, 111
Tours, 44
Trelease, Dr. William, 96, 97
Trew, Christopher Jacob, 108
Tucker, Mayor Raymond R., 25

Vandas, 18
Van der Ast, Balthazar, 103
Van Schaack, George B., 95
Veiled Prophet Queen, 39
Velick, Bernadette, 118
Vishnupersaud, 113, 114

Wallich, Nathaniel, 112, 113
Wandelaar, J., 117
Wedel, Rev. Theodore O., 36
Weiditz, Hans, 101
Went, F. W., 25, 48, 81, 87, Review of Julian A. Steyermark's "Vegetational History of the Ozark Forest," 89
What's in a name? 83
Woodcut, 98
Woodson, Dr. Robert E., 26

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SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at TOWER GROVE, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the TOWER GROVE mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. spring to fall and until six in the winter time though the greenhouses close at five. TOWER GROVE, itself, Mr. Shaw's old country home, is open from one until four, admission twenty-five cents, with special guides. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one most used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southhampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 A. M., but is closed on Saturdays, Sundays, and holidays. The Cleveland Ave. gate, 2121 Tower Grove, is nearly always open, and there is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., adjacent to State Highways 50 and 66. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.

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THE CHARLES DARWIN YEAR

Featuring an article by Dr. F. W. Went about insectivorous plants. Mr. Darwin also was very interested in these plants and contributed much to our early knowledge of carnivory in the plant world.

Cover: Camellia japonica

The first Curtis Camellia Plate. Single-flowered Camellia illustrated in the Botanical Magazine, Plate 42, March 1788.

Camellias named for George Joseph Camellus, a Moravian Jesuit who traveled in Asia in the 17th Century, belong to the Tea Family of plants, Theaceae. The flowers either single or double are white, pink through to rich red. The doubles attain a symmetry of form near perfection. These plants are tender north of plant zone 6.

The time of flowering is primarily in January and February. You can see a beautiful display of the more common varieties now in the Linnean House of the Missouri Botanical Garden.

CONTENTS

Plants of Prey
The Darwin Controversy
Caring for Christmas Plants
Ivy Vine or Bush
Tower Grove
Archeological Cucurbits
Book Review
Missouri Botanical Garden Programs

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PLANTS OF PREY

DR. F. W. WENT

WHEREVER one investigates plants, and whatever observations are made, they always are interesting. Yet some plants are more spectacular, and others are more amazing when viewed from a human standpoint. Among the latter the carnivorous or insect-eating plants take first place, but let me state at the outset that there are no plants able to catch and digest any animal larger than a cockroach. Man-eating plants only exist in the realm of fiction.

Charles Darwin was equally versed in botanical, zoological and geological problems. If he had not published his evolutionary theory, for which every man and child knows him, he would be held in equal esteem by the scientific world for his work on coral reefs, fertilization of flowers, movements of plants, the means of distribution of plants and animals and many other subjects. For example, he was the discoverer of carnivory in plants. His eye and mind were always on the alert, which was partly responsible for his phenomenal achievements. Thus he tells himself, "In the summer of 1860 I was idling and resting near Hartfield, where two species of *Drosera* abound, and I noticed that numerous insects had been entrapped by the leaves. I carried home some plants, and on giving them insects saw the movements of the tentacles, and this made me think that the insects were caught for some special purpose." He found that these movements were caused by nitrogenous compounds, and that digestive enzymes dissolved the insect. Darwin relates: "During subsequent years, whenever I had the leisure I pursued my experiments and my book on 'Insectivorous Plants' was published in July 1875. The fact that a plant should secrete, when properly excited, a fluid containing an acid and ferment closely analogous to the digestive fluid of an animal, was certainly a remarkable discovery." During his work with the sundew, *Drosera*, Darwin became so excited that he wrote the father of Botany in the United States, Asa Gray: "You are unjust on the merits of my beloved *Drosera*, it is a wonderful plant, or rather a most sagacious animal. I will stick up for *Drosera* to the day of my death."

There is no doubt that many carnivorous plants digest their prey, and grow better when their diet of mineral salts is augmented with meat. But it also has been shown that they can live and grow without trapping insects. What does the meat do to them. To answer this, we must realize that all meat-eaters among plants grow in peat bogs or swamps, which, generally speaking, are places with a very poor nitrogen and nutrient supply of the soil. It seems likely that these plants do not use their digested prey as a source of protein, but merely as a source of nitrogen and other nutrients. If this is true they would do the same things as the ant-plants, only in a more elaborate way. Many of the plants which furnish room (and sometimes board) to ants profit from the refuse of the ants, through uptake of the nutrients it contains. The insect eating plants are less subtle, they trap or grab their prey, and decompose it to get at the nutrients. This in itself is an interesting fact, but more interesting is the way insects are caught. For a review of these methods we do best by turning to the delightful book, by the late Professor Francis E. Lloyd, entitled, "The Carnivorous Plants." With fine humor, seldom encountered in scientific books, he places the insect-catching plants in six major groups: pit-falls, lobster pots, snares, fly-paper traps, steel traps and mousetraps. The simplest device is the pit-fall. In northern California a typical example grows, *Darlingtonia* or the cobra plant. In the South, e.g. in the Carolinas and Georgia, another example of the type is found, *Sarracenia.* Each leaf is rolled into a tube-like pitcher, which is twisted at the top so that the entrance to the pitcher points downward. Around its mouth the margin is bent inwards and lined with retrorse stiff hair so that insects which entered the pitcher cannot crawl out again. They are attracted by a violet-like odor. There is no lid which closes with a catch, it is not a trap but a pit. Inside the pitcher some water is always present, but after a prey is caught, there is a 3–10-fold increase in its contents. *Darlingtonia* does not excrete to digest the prey, for this it depends on bacteria.

OLD M.B.G. PHOTO

Sundew *Drosera brevifolia*

Sometimes these plants overeat. Their pitchers get filled with dead insects, which start to rot and kill the leaves. I have seen one or more cockroaches trapped in pitchers in the greenhouse, but they gave too rich a brew, and the pitchers disintegrated, together with their catch. In some Botanical Gardens the pitcher plants have to be protected with screens, since they seem too attractive for insects. And no wonder, for *Nepenthes*, an Asian genus of pitcher plants, produces nectar in its traps.

"Without telling more about the wonders of the pitcher plants, and skipping the lobster pots and snares, the fly-paper traps need our attention. The best known plant in this group is the sundew, *Drosera.* It grows in peat bogs all over the world, and is very common in the north and east of our country. The small plants consist of a rosette of leaves with a graceful flowerstalk carrying several white flowers between them. Each leaf is covered with glands sitting on long stalks, resembling tentacles. These glands secrete a sticky slime so that any small insect which comes in contact with the slime, sticks to it. Then the tentacles surrounding those holding the insect fold inward over the prey, which thus is pressed against the leaf, and digested by an enzyme. Not only insects, but also small bits of egg white or meat are accepted and digested. This is a fascinating thing to observe, and it can easily be seen in plants brought home from a peat bog.

The Venus fly trap, *Dionaea,* occurs in the Carolinas and is an example of

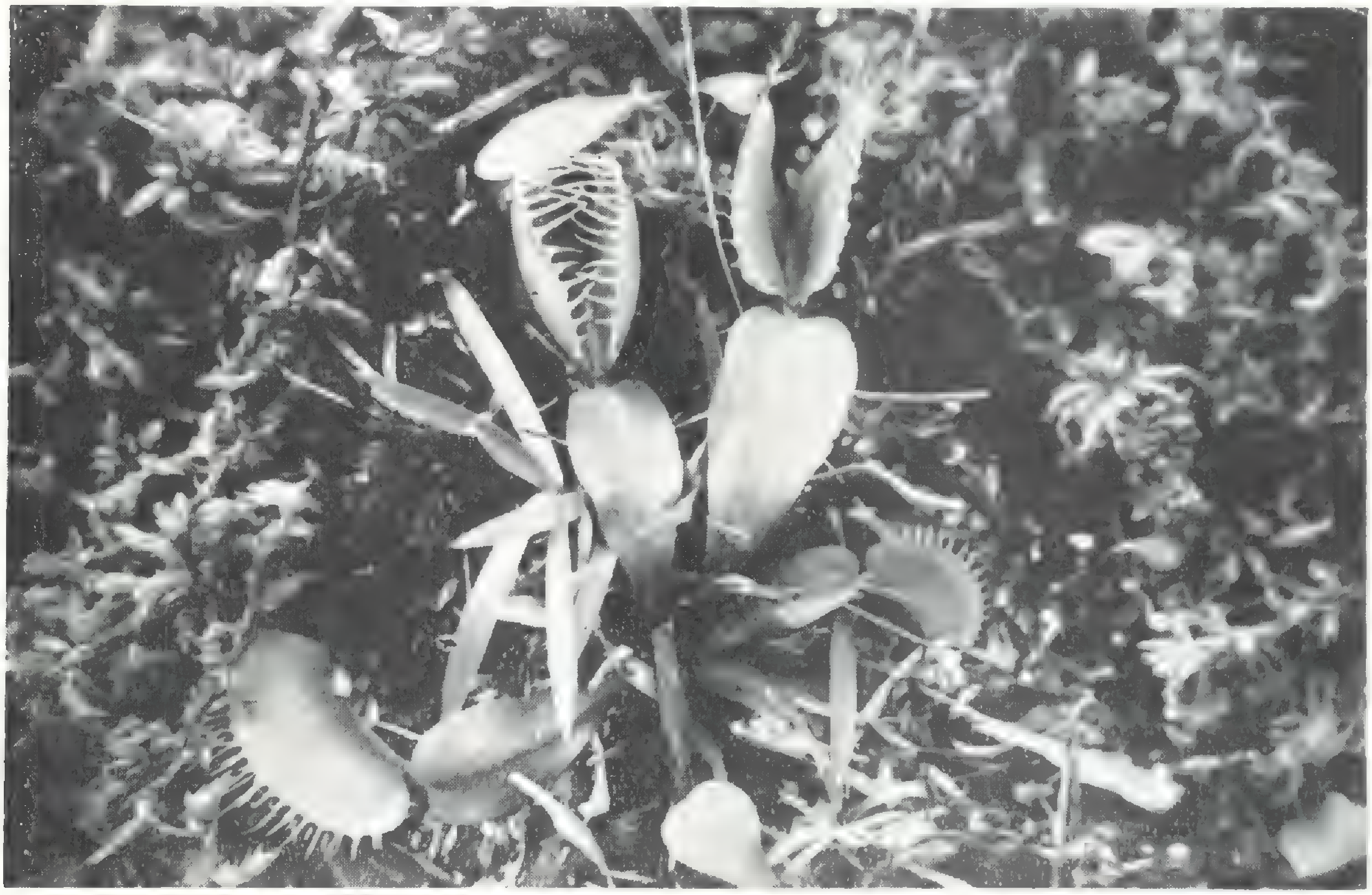


PHOTO BY E.L.E.

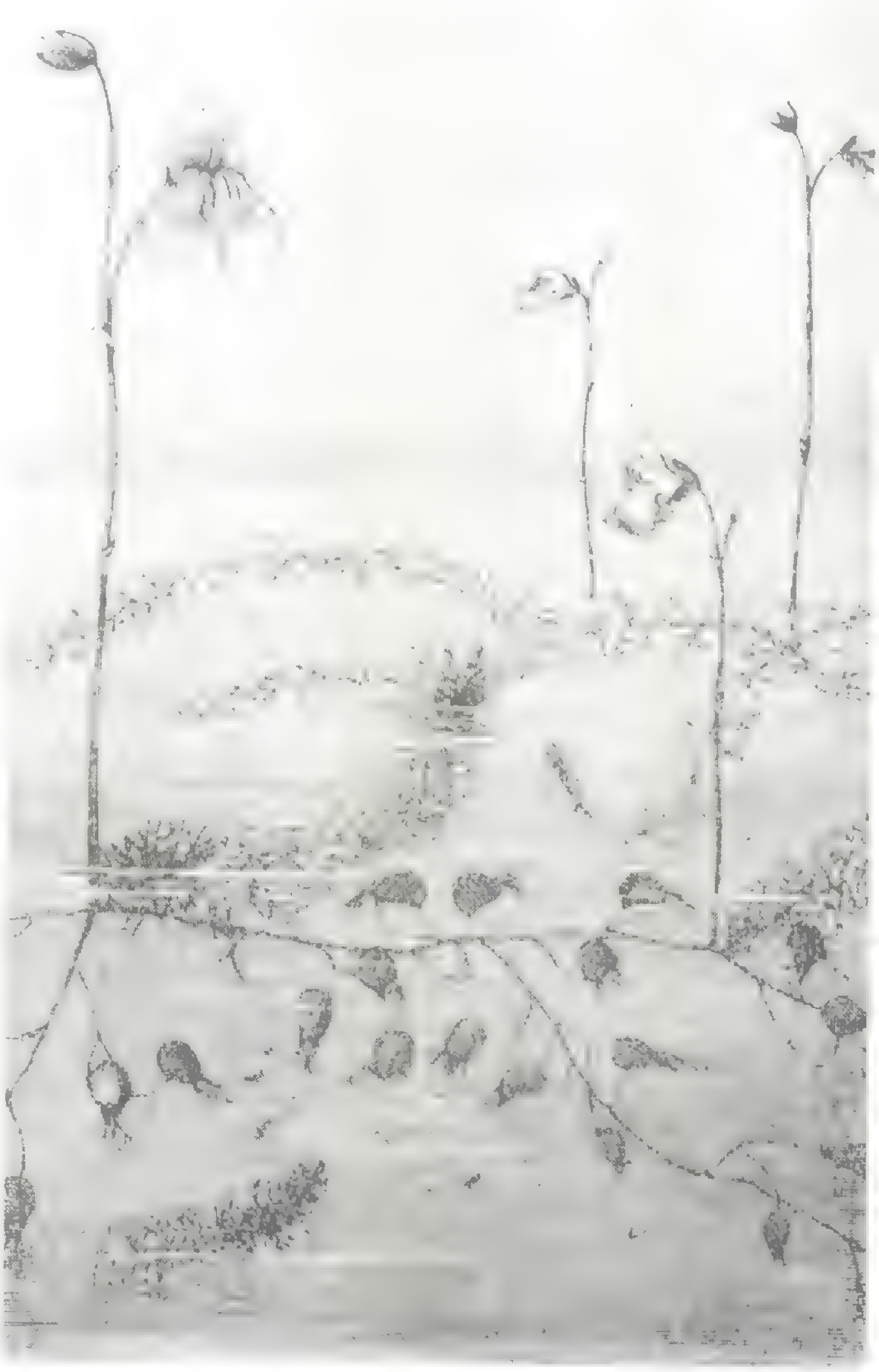
Venus Fly-trap *Dionea muscipula*

the steel trap. In size and general build the plant resembles a sundew, but the roundish leaves are hinged and can fold upwards along the middle. On the inside of each valve three hairs stand. When these are touched twice the trap closes suddenly. Since the margins of the leaf have teeth, which mesh when closed, any insect unfortunate enough to touch the sensitive hairs while walking on the leaf will be enclosed by the two valves, and escape is impossible because the teeth form the bars of a cage. On the inside of the valves glands excrete a digestive fluid, and in a few days only the indigestible skin of the insect is left. Then the leaf may open again, to trap another insect. On warm days the closing movement of the trap is so fast that a comparison with a steel trap is very apt. It takes less than a second to close when the temperature is high, but on cool mornings the trap may not close at all after stimulation.

A particularly interesting detail is that only upon a double stimulation of the sensitive hairs the trap closes. One single hair must be touched twice in a few seconds interval, *or* two different hairs can be touched once each, also with a short interval. Therefore a little pebble or inanimate object cannot cause closure, but an insect walking between the hairs is most likely to make two touchdowns, and become trapped.

Another plant having similar, but simpler traps is a water plant, *Aldrovanda.* This forms a long stem with whorls of leaves, each surmounted by a tiny trap.

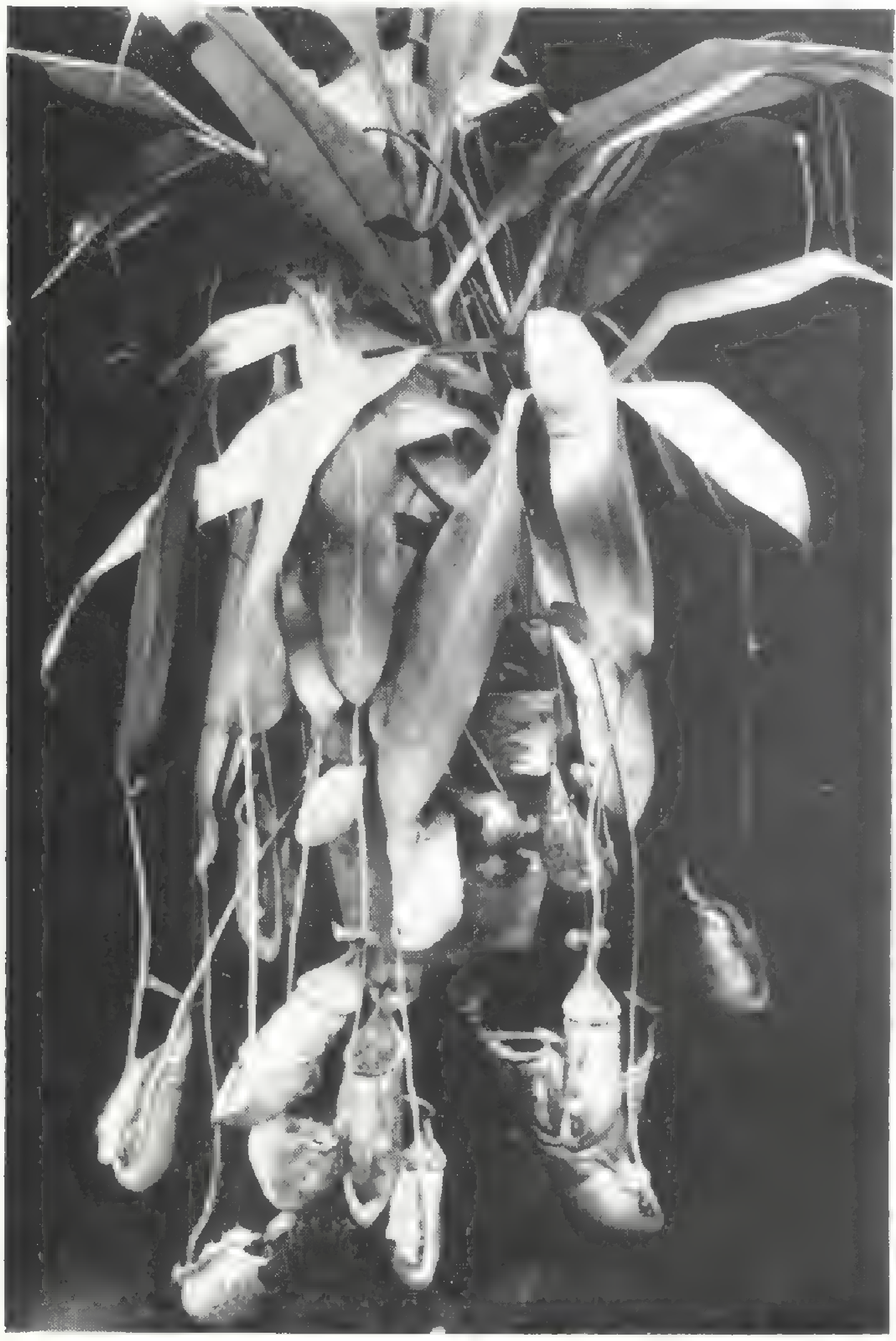
The mouse trap mechanism of trapping is represented by the bladderwort. *Utricularia.* Almost 300 species are known, most of them living in water. Their yellow flowers are delicate, or sometimes showy, but of greatest interest are their traps. They are quite small, usually not more than a few millimeters. Professor Lloyd has studied them in detail and most of what we know about their astounding mechanism is due to his researches. The trap consists of an almost round



REPRINT OTTO LUGGER
Bladderwort *Utricularia sp.*

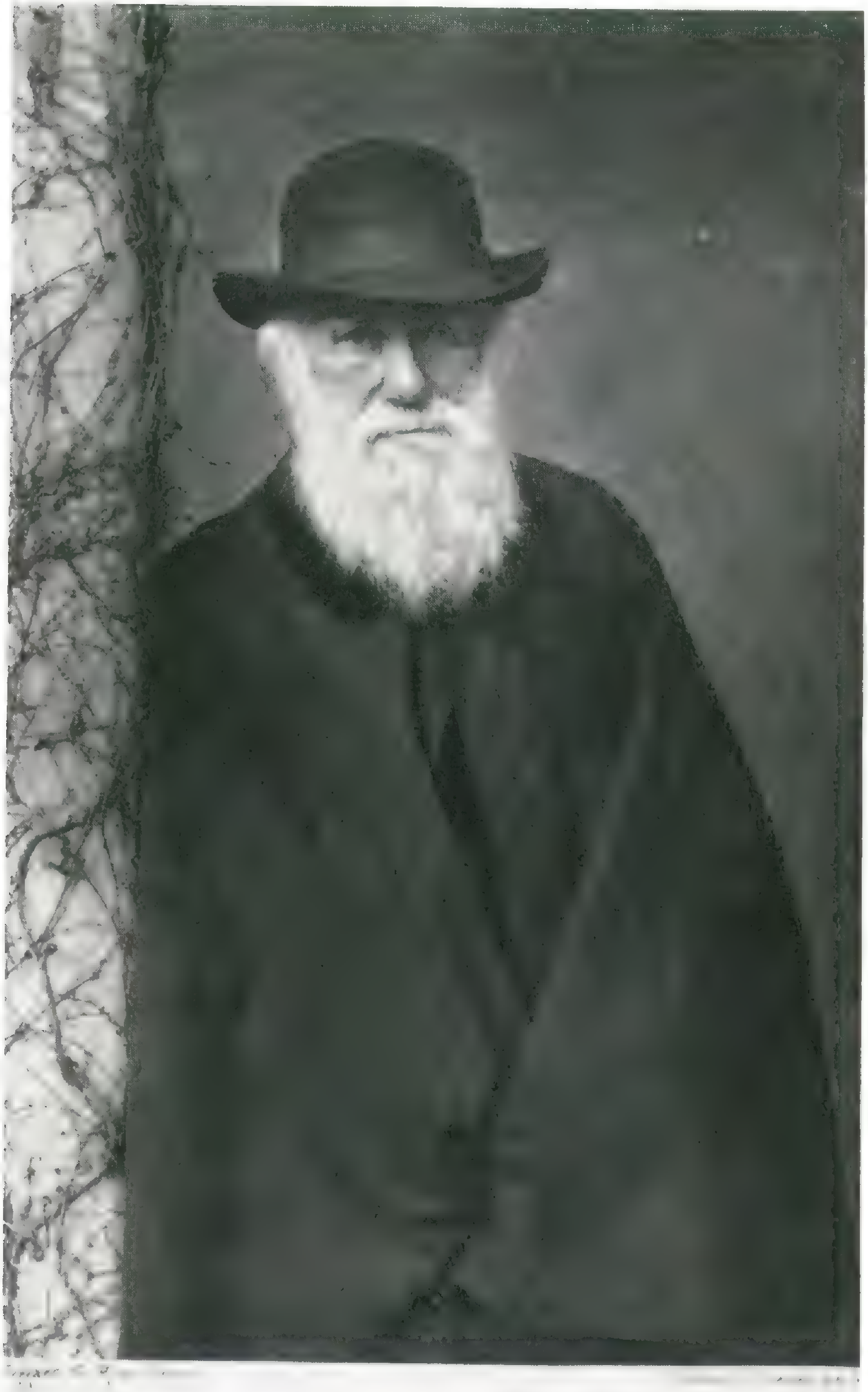
sac, with one small opening, closed by a door or valve. This is not a passive check valve, which has to be pushed open by the prey and falls shut behind it, but a door which closes tightly against a sill, preventing it from opening. Water is pumped out of the bladder, and, since the door is hermetically closed, the sides of the bladder are pulled inward and a tension is developed inside. On the outside of the door are a few sensitive hairs. When they are touched the door gives and water is sucked into the bladder with great rapidity. Any small animal (usually a *Daphnia* or similar crustacean) is caught in this rush of water, and within one-tenth of a second the trespasser is inside the bladder. The door closes again, enzymes are excreted, and the prey is digested.

The carnivorous plants belong to seven different families. It is remarkable how, in the course of evolution, meat-eating habits are developed in those seven separate families. Not only mechanism for digestion and absorption of the nutrients from the prey had to be evolved, but equally, in each family individually important mechanism to lure and catch the prey had to develop. One without the other would have been useless so that we have to conceive that the digestive, luring and catching mechanism all developed simultaneously.



Pitcher Plant *Nepenthes dominii.* Traps developed on tips of leaves and contain nectar.

Photo by G.H.P. M.B.G. BULLETIN Vol. 38:2. p. 29.



Ch. Darwin

THE DARWIN CONTROVERSY

Momentous Book on Evolution Has Its Centennial

SAM LAMBERT

One hundred years ago, on November 24, 1859, a momentous book appeared in England. It sold out its first edition of 1250 copies in one day and started a thunderous controversy that is still felt in some degree. The book, bearing the lengthy title "On the Origin of Species by Means of Natural Selection," was written by Charles Darwin. His thesis—that plant and animal life emerged from lower forms of life rather than having been created directly—challenged literal interpretation of the Book of Genesis and shattered the complacency of the Victorian world. Also, it opened to general critical study the origin of man and his relation to nature.

Darwin's epochal book had its beginning some 25 years earlier when, as a young naturalist, he made a five-year scientific voyage aboard the Royal Navy brig *Beagle* to South America and the islands of the Pacific. From his observations of plant and animal life in the many places he visited, Darwin was struck by the possibility many species had evolved from a common source. He explained this evolution by natural selection—that infinite variations among plants and animals sometimes result in characteristics that are transmittable through heredity and that are an advantage in the constant struggle for existence. The fittest survive, he concluded, and the result is a continuing development of a higher form of life. The implication that man also evolved from a lower form was spelled out in 1871 in "The Descent of Man."

After returning to England from his voyages aboard the *Beagle*, Darwin married his cousin, Emma Wedgwood, in 1839. They moved to a big country home, Down House, in Kent and raised a large family. There he continued his scientific studies, became acquainted with the views of the English economist Malthus, the philosopher Herbert Spencer, the geologist Lyell, and the French naturalist Lamarck.

Darwin kept his theories on evolution largely to himself until 1858, when he saw them mirrored in a manuscript by Alfred Wallace, a young British naturalist. This led to the joint presentation, at a science meeting, of their work. However, the documentation and style of the "Origin of Species," published the next year, was responsible for the theory of evolution being linked with Darwin's name.

Unfortunately, many of Darwin's generalizations were overemphasized and the term "Darwinism" came to be used to justify, among other things, cut-throat competition and a callous social outlook. Darwin himself was open-minded and humble about his views. Personally, he was not antireligious, once remarked that the universe was too complex to have arisen "through chance."

Reprinted from *St. Louis Post Dispatch*, Sun., Nov. 22, 1959

CARING FOR CHRISTMAS PLANTS

A WALK through a greenhouse where plants are being readied for Christmas is a delightful experience. The plants look so fresh in the bright sunlight and you are conscious of the warm, moist air all about. Now step into the modern home where these plants are used for holiday decorations or arrive as gift plants. If plants could talk, can't you just hear them complaining of their discomfort in the hot, dry, stuffy atmosphere of the home? While they are silent none-the-less their actions are louder than words. The one plant that reacts almost immediately to the sudden change in environment is the popular Christmas *Poinsettia*. Knowing this, every effort should be made to treat it well. Try and select a cooler location in the room free from drafts, but where there is plenty of daylight. Never let the plant dry out and yet do not overwater it. When a pot of brilliant red *Poinsettias* is brought to the home the plants are in prime condition. They flourished under the best growing conditions in the greenhouse and have developed their bracts since mid-November. In December they were fully grown and had they been left in the greenhouse would have remained in prime condition for six to eight weeks or longer In the dry atmosphere of the home *Poinsettias* will be good for about a week and after that will begin losing the lower leaves and some of the bracts. Unfortunately, that ends their attractiveness as a house plant. It is possible to grow them again the following year, but it takes time and care and that is another story.

Some other colorful red and green fruited plants are the Jerusalem cherries, and peppers. The cherries and peppers are not so quickly affected by temperature changes and remain in good condition for a longer time. They are annuals and are grown from seed each year. After the fruits have shriveled or dropped the plants may as well be discarded. The seed can be saved and used to produce new plants.

Kalanchoes in shades of rich red and orange bloom for a long time and, being succulents, they easily adapt themselves to the dry environment of the home. They are good, colorful, long lasting Christmas plants.

Cyclamen can be kept beautiful by growing them where it is cool and by giving them plenty of moisture. This will also keep them blooming for a long time. They have interesting

PHOTO BY P.A.K.

Cyclamen

leaves and even after they have stopped blooming are still very attractive plants.

Azaleas also like to be cool and moist. If these conditions are met they will bloom for several weeks. On a sun porch they can stand temperatures between 35 and 40 degrees and if such a location is available that is the best place to keep the plants until they can be taken outdoors in a semi-shaded spot during the spring and summer months. While outdoors feed them at monthly intervals, alternating ammonium sulphate with a soluble fertilizer. The plants must be brought indoors before the first frost and will bloom again in February and March.

African violets, Begonias, Gloxinias, Chrysanthemums and foliage plants like Philodendrons, ivies, Ficus, Bromelias and hollies are just a few of the many plants available for Christmas. Regardless of the kind of plant, the essentials for good growth are moisture, light, proper temperature and a regular feeding time.

How often a plant should be watered is a puzzling question frequently asked and one for which no satisfactory answer can be given. So much depends upon the kind of plant, the type of container, the humidity or air and the soil in which it is planted. Cacti and succulents need less water and can endure longer intervals without water than plants like ferns and *Azaleas*. If there is little space for water because the plant has been potted high, one watering will not suffice and will moisten only the surface soil. Such a plant had better be set in a pan of water and left there until the entire root ball has been moistened. Plants will dry out faster on cold days because more heat is circulated in the home. On mild, damp days there is little need for heat and there is a corresponding decrease in the water requirements of the plants. Every effort should be made to increase the humidity near the plants by placing them in saucers of damp sand, gravel or peat. Plants on a windowsill usually do not dry out as fast as those in the room.

Plants need good light, but they vary in their light requirements, flowering plants needing more than foliage plants. Some plants, like African violets, can be grown without daylight and thrive just as well under fluorescent lamps.

High temperatures and low humidity will ruin most plants. If it is impossible to avoid such conditions some kinds of plants may be grown in plastic or glass enclosures, referred to as wardian cases, where humidity can be controlled. PAUL A. KOHL

PHOTO BY P.A.K.

Gloxinia

IVY VINE OR BUSH

PLANTS that we think of normally as being vines attain a new interest when we find we can grow them as shrubs. There are a number of vines which produce a low arborescent or bushy type of growth and as such can be used for accent or specimen plants, tub or pot plants or even hedge rows. Certain vines will become bushy or tree-like by special training; some grow this way after removal or loss of their accustomed support; more often the condition occurs when a plant reaches a state of maturity and takes a bushy form in order to place its flowers and fruits more advantageously for pollination and seed dissemination. Examples of these phenomena of plant behavior are (1) Wisteria *(Wisteria floribunda)*, (2) poison ivy *(Rhus toxicodendron)* the bush form of which is known as "poison oak," and (3) the evergreen groundcover vine English ivy *(Hedera helix)*.

The English ivy, and the various strains, named for locations where this plant has adapted itself to climatic conditions such as Bulgarian, Roumanian and Scandanavian, is an interesting evergreen when used as a shrub, either separately or in conjunction with the vine form as a ground cover. The shrub form, or sexually mature state of the English ivy, comes about at a dramatic point when age, conditions of growth or some unknown stimuli cause this plant to change its style of growth. Instead of a creeping vine it now becomes bushy with sturdy branches and uniformly simple heart-shaped leaves of leathery texture. This form usually occurs after the plant has climbed a tree, a fence or a wall. Propagations made from this adult growth are much more difficult to root than those made from the juvenile or vine form. They will, however, retain their adult characteristics and grow bush-like when planted alone. They will produce numerous round, globe-like inflorescences which are both interesting as flower designs and as heads of dark blue berry-type fruits. Not much is known of their ultimate size or age behaviour. Plants in the Garden four to five years old are only two to three feet in height.

PHOTO BY E.L.E.

English Ivy *Hedera helix*. Adult or bush-type growth.

Potted specimens for indoor, patio or porch use can be grown and trained to be satisfactory and interesting dark green foliage plants. They will thrive and grow under the exacting conditions of the hot dry air of our modern homes. They need strong light, but not direct sun, for best health. They must be kept moist, but not soggy wet, nor must they be allowed to stand in a saucer of water. An occasional washing off under a shower or a stiff spray from a hose will keep the leaves clean, free of spiders and mites and will keep the plant growing vigorously.

The Missouri Botanical Garden has pioneered in the field of providing a good hardy strain of ivy ground cover for the St. Louis region. The Bulgarian ivy, which Dr. Edgar Anderson selected after trials of ivies from many places, seems to be admirably suited to our colder winters and more especially to the hot dry months which are equally exacting for plant survival. The adult form of this ivy grown as a bush is also proving to be interesting and attractive to plant lovers.

E.L.E.

NEW CLIMATRON

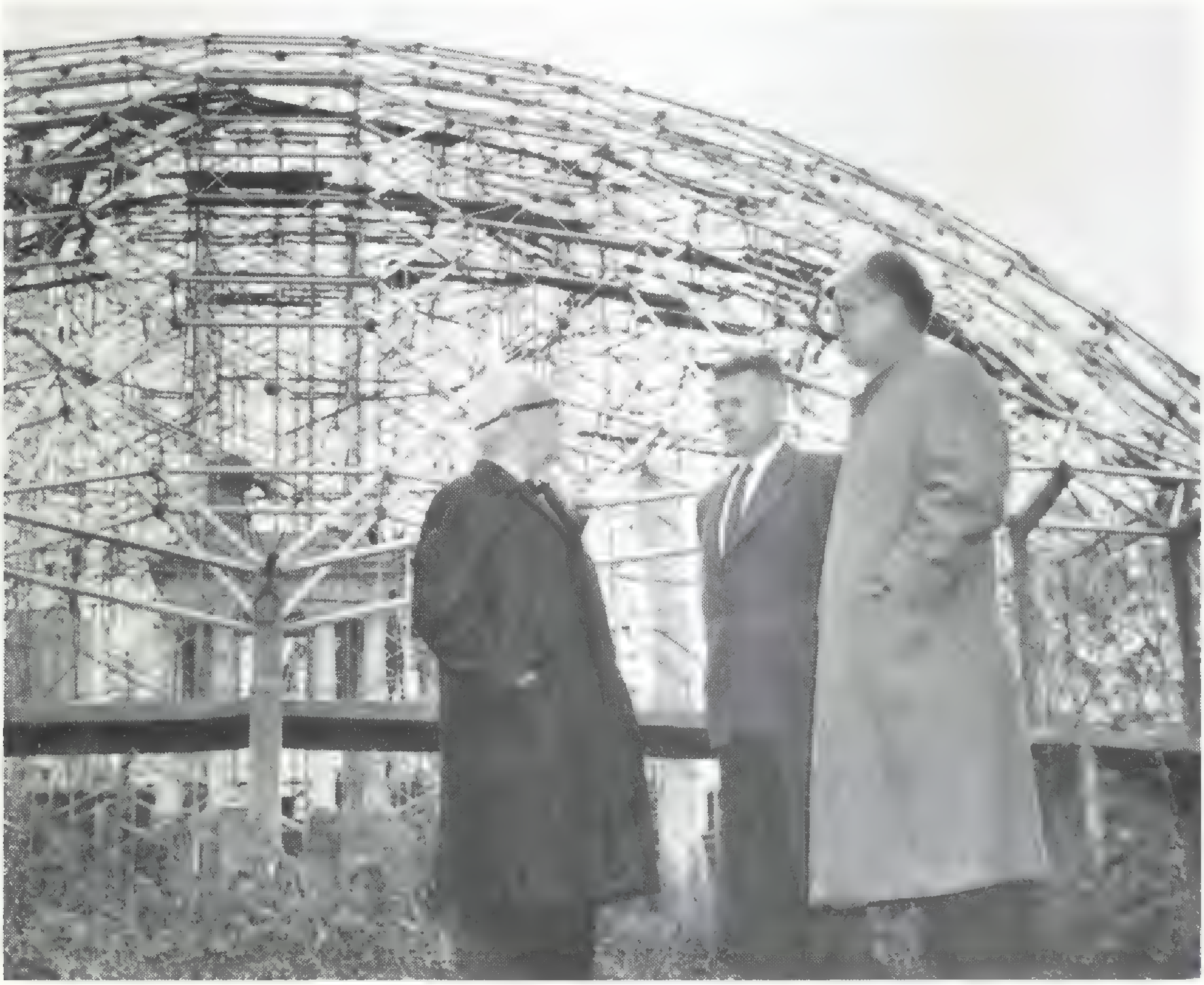


PHOTO BY LEMOINE-SKINNER

The New Climatron which replaces the old Palm House is nearing completion with the framework now in place. Left to right, Buchmeister Fuller, Hugh Cutler, and Eugene Mackey. Photo November 1959.

TOWER GROVE

THE Henry Shaw Memorial Association, under the direction of Mr. John S. Lehmann, early in 1953 began restoration of Mr. Shaw's country home preparatory to opening it to the public. Mr. John Albury Bryan and the late Mr. Guy Study were the Architects in charge of restoration. The house, partly restored, was opened to the public in 1953, with the Eighth District Federation of Women's Clubs acting as hostesses. Mrs. Arthur J. Kreuger and Mrs. Geo. H. Pring, working with the Federation, have supplied hostesses on a volunteer basis for the past six years.

In 1954 much needed structural repair work was made possible by a substantial gift of money from Stix Baer and Fuller Company of St. Louis.

More recently, during the past year, work of restoration has been advanced through efforts of the Historical subcommittee of the Women's Association of the Garden together with Mr. Bryan, the Architect. Directly responsible and active in the work were Mrs. E. R. Culver, Jr., and Mrs. Neil Woods with consultation by Mrs. Fothergill Graves, Interior Decorator.

PHOTO BY LEMOINE-SKINNER

Hostess reception November 16, 1959, commemorating six years of volunteer service as hostesses in the Henry Shaw Home by members of the Eighth District Federation of Women's Clubs. Mrs. Walter H. Millan, the first volunteer hostess (seated), Mrs. Arthur J. Krueger and Mrs. Geo. H Pring, who arrange for volunteer hostesses on a regular schedule, and second row, Mrs. L. P. Whiting and Mrs. Fred Steinkuhle.

ARCHEOLOGICAL CUCURBITS

Culture of man traced by his use of gourds, pumpkins and squash

Dr. Hugh Cutler, Executive Director of the Garden, has assembled one of the best collections of archeological cultivated plants in this country. Most of the items in the collection are corn, cucurbits and beans, but there are a great many specimens of other vegetable materials. For several years Dr. Cutler and I have been making a survey of the archeological cucurbits of North and South America, aided by a grant from the John Simon Guggenheim Memorial Foundation. The purpose of the survey is to trace the distribution of the cultivated cucurbits in time and space, linking their distribution with the migration and development of cultures.

The cucurbit materials recovered by archeologists from excavated sites usually consist of a number of charred, broken pieces of what was originally the rind of the fruit; some weather-beaten, eroded and decayed seeds; and a few battered peduncles (fruit stems), frequently riddled with insect tunnels. If accurately dated, a surprising amount of information can be gained from these bits of debris, in spite of its rubbish-like appearance. From a close examination of the rinds we can usually assign the material to the proper genus; i.e., either *Lagenaria* or *Cucurbita.* If the seeds are not too badly eroded or decayed, we can normally place them in the correct species. The peduncles can be readily identified by the expansion or flaring at the fruit attachment, by the angle and depth of the longitudinal ridges, and by the amount and texture of the corky enlargement. Some results already published indicate that *Cucurbita pepo* (summer squash, pumpkin, ornamental gourds) was being grown for food as long as 7000–9000 years ago.

In collaboration with a colleague, Dr. G. N. Davis, I am also preparing a manuscript on "The Botany, Cultivation and Uses of the Cultivated Cucurbitaceae." Consultations with Dr. Cutler and Dr. George B. Van Schaack, along with the rich collection of books in the Garden Library relating to the origin and early use of cultivated plants, have been helpful in advancing this project.

Thomas W. Whitaker
Geneticist
U. S. Department of Agriculture
La Jolla, California

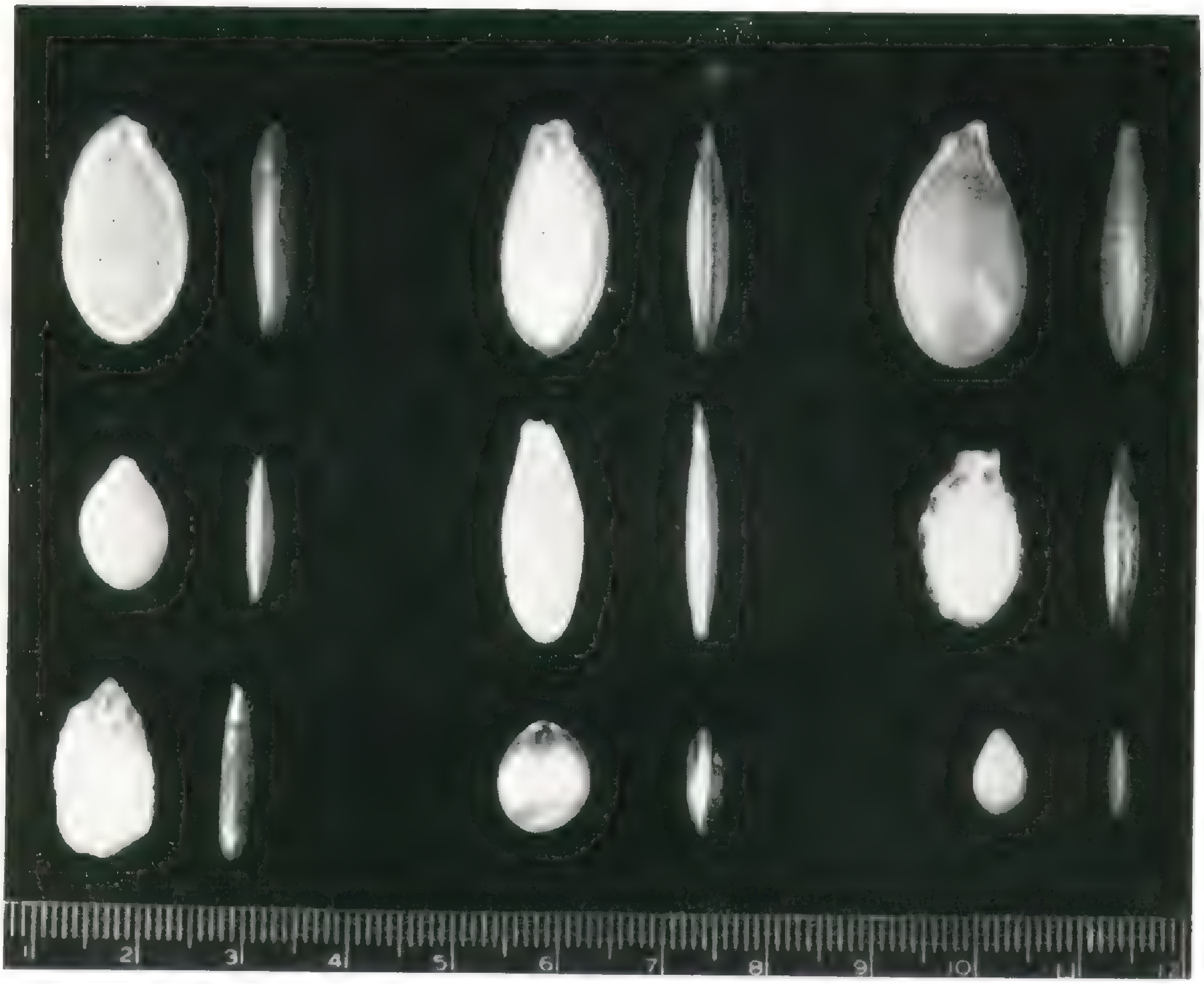


PHOTO BY T.W.W.

Fig. 1. The cucurbit seeds in the above illustration are representative of present day varieties. By comparing the gross morphology (form) with modern varieties, archeological cucurbit seeds can be identified with considerable precision.

Upper row left to right

Cucurbitas mixta var. *Taos*; *C. mixta* (common); *C. molima*

Center row left to right

Cucurbitas pepo (small); *C. pepo* (large); *C. moschata*

Lower row left to right

Lagenaria siceraria; *Apodanthera* sp.; *Cucurbita foetidissima*

Apodanthera sp. and *C. foetidissima* are not cultivated plants but their seeds are occasionally found in vegetable material from archeological sites. The seeds of *Apodanthera* were used for food while the pulp and fibres of *C. foetidissima* were used in cleaning and scouring.

BOOK REVIEW

The Garden Flowers of China. By H. L. Li, Taxonomist of the Morris Arboretum and Associate Professor of Botany, University of Pennsylvania. The Ronald Press Company of New York. Copyright 1959. 231 pages. Price $6.50.

Dr. Li in this book has brought together a comprehensive interesting presentation of China's contribution to horticulture. The bibliography is extensive and ranges over a period of nearly a thousand years. He gives a background of history, together with the lore and symbolism of many of what we consider "our" common garden flowers. The book is artfully illustrated with drawings and photo plates and would be most helpful if you were considering making a new garden, revamping an old one or if you wished to add something new. This is particularly true if you want to add an oriental flavor to your garden.

Much of the great joy of having a garden lies in the ability to know how to appreciate the flowers and to converse with your friends about the background, the culture and the use of these flowers, both in the garden and in arrangements. Dr. Li's book presents this lore and romance about many of the common garden flowers which originated in China in a modest readable fashion. The flower lovers will find the book fascinating to read as well as informative and helpful in making their gardens both attractive and personal.

E.L.E.

MISSOURI BOTANICAL GARDEN PROGRAMS

Special Shows and Displays in the Floral Display House:

Poinsettia Show, December 12, 1959, to January 15, 1960.

Orchid Show, January 23 to February 28, 1960.

Free nature programs for children, seven to ten and eleven to eighteen, are held every Saturday morning from 10:00 to 11:30 A. M.

Dead or Alive?	January 2
Winter Puzzles	January 9
Do You Have a Green Thumb?	January 16
Jungle Plants	January 23
The Green Thumb at Work (on your own plants)	January 30
The Mystery of the Orchid	February 6
Color Sound Movies	February 13
Plants in a Capsule	February 22
Three Cheers for the Green Thumb (you can take your plants home)	February 27

Free summer programs of nature study for children are supported by a gift from the Pitzman Foundation. Trails, craftwork and group activities are offered. Schedules for these programs may be obtained in June from the Main Gate.

COURSES

The following courses are open to any interested person. Certificates are awarded upon successful completion of any course. Information on registration may be obtained by calling PRospect 6-5567.

Please send all registration fees to

Missouri Botanical Garden
2315 Tower Grove Ave.
St. Louis 10, Mo.

Registration fees cannot be refunded after the last day of registration for any particular course.

The courses will meet in the classroom of the Museum Building. To reach the Museum enter the Garden through the gate opposite Cleveland Ave. at 2221 Tower Grove Ave. The building on the left.

GROUNDS CARE

Course 151. Area Management—For the landowner with one to fifty (or more) acres.

Place: Classroom, Museum Building

Time: Five Thursday nights in February (course given in alternate years. Next session 1961).

Fee: $15.00 for the five meetings

Enrollment: Limited to 20 students. Please register early.

A course specially designed for those having small acreages in the country. Principles of erosion control, control of weeds and brush, basic management of ponds and specialized management of meadows, marshes and forests for maximum recreation and enjoyment of wildlife will be explained and demonstrated. A course full of practical things you need to know. Instruction in agricultural crops and livestock care will not be included.

HORTICULTURE

Course 121. Plant Propagation.

Place: Classroom, Museum Building. Practice work, Experimental Greenhouse.

Section I, Monday afternoons, 1:00 to 3:30 P. M., January 11 and 18.

Section II, Tuesday nights, 7:30 to 10:30 P. M., January 12 and 19.

Section III, Thursday mornings, 9:30 to 12:00 noon, January 14 and 21.

Section IV, Friday afternoons, 1:00 to 3:30 P. M., January 15 and 22.

Fee: $12.00 for two meetings.

Enrollment: Each section is limited to 25 students. Please register early.

Each period will include a lecture-discussion, followed by a student practice session.

The course will emphasize the following methods of vegetative propagation: root cuttings, suckers, divisions, hard and soft stem wood cuttings and leaf bud and scale propagations.

Student practice will emphasize propagation of house plants such as Begonias, Dieffenbachias, Philodendrons, etc. Some attention will also be given to hard wood cuttings.

Each student will be provided with one plastic covered propagating box and 40 to 50 kinds of cuttings.

Instructors: Clarence Barbre and Kenneth Peck.

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SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at TOWER GROVE, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the TOWER GROVE mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. spring to fall and until six in the winter time though the greenhouses close at five. TOWER GROVE, itself, Mr. Shaw's old country home, is open from one until four, admission fifty cents, with special guides. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one most used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southhampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 A. M., but is closed on Saturdays, Sundays, and holidays. The Cleveland Ave. gate, 2221 Tower Grove, is nearly always open, and there is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., adjacent to State Highways 50 and 66. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.

Fundamentals of Pruning Ornamental Trees and Shrubs

MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME XLVIII No. 2 FEBRUARY 1960

MISSOVRI BOTANICAL GARDEN
1889

Cover drawing by Louis G. Brenner

CONTENTS

Fundamentals of Pruning Ornamental Trees and Shrubs

The Response of Plants to Pruning
F. W. Went

The When and How of Pruning
Louis G. Brenner

Missouri Botanical Garden Programs

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Vol. XLVIII No. 2 February 1960

FUNDAMENTALS OF PRUNING ORNAMENTAL TREES AND SHRUBS

Amateur gardeners and home owners often find pruning of trees and shrubs a phase of gardening clothed in mystery and best left to the services of the professional, or if practiced at all, done with little understanding of the purposes and effect upon the plant. We present here the basic fundamentals of pruning, as we understand them to start the home gardener into a most interesting, engrossing and necessary aspect of caring for his garden. It is hoped this explanation will lead to an even deeper and more serious interest by the gardener who may wish to read and use the more detailed information presented by the authors suggested on the last page.

THE RESPONSE OF PLANTS TO PRUNING

F. W. WENT

A gardener can do a better job of pruning if first he understands what happens to a plant when it is cut or injured in any way, and second, what the plant will be like after it recovers from the operation. The foremost consideration in any pruning or trimming of plants is the buds.

DESIRABLE BUDS

A branch can only develop from the pre-formed buds, which are found at the end of a branch, or just above any place where a leaf is or was attached to a branch. If every bud grew, any plant would soon be a solid mass of branches. This happens at limited points in some diseases, such as the "witches broom." A plant has, however, a special device which makes only one out of every ten to one hundred buds grow, the rest being left as a strategic reserve, which can be called upon when the growing shoot is injured, cut off, or eaten by animals.

The method by which the plant keeps most buds inactive is that of diverting all food and other materials necessary for growth towards a relatively few growing buds, keeping the others starved. As soon as the growing bud is removed, the diversion stops, and the buds left nearest the cut immediately take advantage of the available food. But as soon as one of them gets the upper hand, it starts to inhibit the others by diverting all food toward itself. Thus no chaos results from pruning. The number of branches which take over from the one which was removed is definitely limited. We know very little about the mechanism of this food diversion. The only thing we can say with certainty is that it is connected in some way with the production of the growth hormone, "Auxin," by the growing stem. The extreme tip and the youngest leaves of a branch produce a large amount of auxin. As soon as the production of this auxin by the branch tip stops, the diversion of food toward that tip stops, and other buds get a chance. When one or a few of these other buds produce sufficient auxin, this diverts the food toward them, and the situation is the same as it was before, except that one or more other branches have taken over from the original one. Thus the plant automatically adjusts itself to the effects of pruning or injury.

By pruning, a gardener can make almost any inactive bud grow. This is of special importance in shrubs and trees which form their flower buds in the year previous to blooming, as in the case of cherries, peaches, apples, plums, apricots and many flowering shrubs. In these deciduous fruit trees, the top buds and the ones of last year's growth are predominnantly vegetative, or in other words, give rise only to leafy shoots, and do not contain pre-formed flowers. The more swollen buds on the older wood are predominantly flowering buds. If left untrimmed, a larger proportion of the developing buds will be vegetative, which not only interferes with the development of flower buds, but also diverts food from growing fruit. When the majority of the last year's shoots are pruned off, a greater proportion of flowering shoots can develop and set fruit. And still a certain number of vegetative buds, which are mixed in with the flowering buds on the older wood, will grow out to keep the plant in a good, balanced condition.

In other plants, like the eastern lilac, the apical buds are usually flower buds, so that pruning during the winter destroys the next spring's flowers. It is not practicable to list for each plant when and where the flowers are pre-formed, but anyone can find this out for himself. A good hand lens and a few needles comprise the necessary equipment. Carefully pare the bud scales and small leaves away from a bud. If it is a flower bud, perfectly developed but as yet tiny, flowers will be found in between the small leaves. If only smaller and smaller leaves are seen inside, the bud was vegetative. All this is visible with a ten-times magnifying glass.

PLUMBING SYSTEMS

There is another—and important—reason why shrubs should be pruned. This is related to the reason why a shrub does not grow into a tree even though it seemingly has all the attributes of a tree. But just as the shoot of a shrub gets a good start it stops growing, and in many cases, it dies back to the ground, and has to begin all over again. Therefore, in the natural state, a shrub usually has much dead wood and has many stems which grow up from the root crown. In this respect a shrub holds the middle ground between a tree and a perennial whose above-ground stems die at the end of each year (aster, delphinium, paeonia). The efficiency of the plumbing system of trees, perennials, and shrubs is the important factor in determining their span of life. The tree is, from every standpoint, an engineering marvel. Its plumbing system is most efficient.

The plumbing system of perennial plants is so inefficient that, after a season's growth, the strain under which the water moves through the vessels has become so great that the buds higher on the stems cannot make good connections and will not grow any more. The whole stem dies, and a bud on the rootstock, near the source of water, starts next year anew.

Something like this happens in shrubs. In the course of a few years, in many shrubs, the growth of the highest buds is not possible because of the relatively poor water supply system. An indication of the water stress is given a few years before the climax, when the new developing leaves stay smaller and flowers become smaller also.

When the main stem of a shrub dies, new shoots start to grow from near the root crown, and take over the place of the dead stem. The plumbing system in these shoots becomes overtaxed in the same span of time, and then everything starts over again.

In this case pruning can help, not by improving the plumbing, but by removing the buds too far away from the roots, causing buds lower down to develop where the water piping system will not be overtaxed so soon. There are different symptoms which show how much of the old branch has to be removed. Wherever the old branch seems thin in comparison with the number of leaves it has to supply with water, it should be cut. The buds on the thicker part of the branch farther down will give rise to more vigorous branches. Also, the branches bearing few and small leaves, as a consequence of a restricted water supply, should be cut off. In this way nature is helped and the shrub can be kept more vigorous, because it is not necessary for the whole branch to die before new shoots can grow.

Thus we have seen that the scientific foundations for pruning are: (a) removal of the less desirable buds, so that the more desirable buds can develop, and (b) removal of the weak buds, poorly supplied with water, thus forcing better located buds to grow. And the reason why new buds start to grow when the growing shoots are removed can be explained by the diversion of food toward the growing shoots.

The above explanation and the pruning directions given on the following pages should constitute valuable reading for every gardener who wants to prune more intelligently. These explanations here should emphasize, for instance, the repeated recommendations that old, useless or weak shoots be removed in favor of desirable and well placed shoots. *The fact that food is diverted to the buds left nearest the cuts should impress the pruner with the importance of carefully considering the placement of the buds to which he cuts during pruning operations on various shrubs and trees.*

THE WHEN AND HOW OF PRUNING

LOUIS G. BRENNER

THE REASONS FOR PRUNING

PRUNING is primarily a process of removing portions of a plant to achieve certain specific results essential in good plant grooming. Some physiological reasons for pruning are set forth in the above paragraphs where Dr. Went discusses response of plants to pruning. Pruning should be undertaken with definite purpose in mind and not just because one sees his neighbor cutting away and decides this might be a good idea, especially if it is a beautiful day to be outside.

Many otherwise fine garden trees and shrubs have been ruined by thoughtless hacking. Valid reasons for pruning may be listed as: shaping or grooming, in which small portions of the plant are removed to maintain general conformity typical of the species; to maintain youthful vigor necessary for flowering and fruiting of shrubs; to improve health by removing diseased or injured parts; to maintain a plant in a specific habit for specific purposes; and to balance the crown to injured root system as occurs in transplanting. Finally, pruning must be undertaken when plants have been injured by storm, romping children or pets, and other accidents.

WHEN TO PRUNE

Proper time to prune has consistently baffled more gardeners than any other part of this relatively simple garden task. Necessarily, time of pruning is directly connected with the purpose cutting is to achieve and will be done in particular seasons of the year. Old hands at gardening say the time to prune is "when the knife is sharp," but his knife is always sharp and is wielded with due consideration for each individual plant. For those less experienced, the following thoughts may prove helpful.

Pruning for Shape

A large part of garden pruning will fall into this group which could perhaps be better named as "grooming." Healthy, vigorous plants quite often need a bit of careful snipping to keep them well formed and this can generally be done best during the growing season while the plant is in leaf. Flowering trees and shrubs, however, would be more properly shaped during the second and third week of July to insure against loss of flower buds on the branch thus shortened. Hedges generally may be shaped (sheared) at any time during the growing season with only the caution that heavy shaping be done in the first cutting and not left until August. Heavy shaping of hedges late in season could cause development of abundant new twig growth which may not mature (become woody) and be subject to winter freezing injury.

Pruning for Vigor and Flowers

Most woody plants, it has been shown, especially shrubs, respond vigorously to pruning, and this is essential toward keeping blooming shrubs in heavy flower. Simple general rules may be practiced by the gardener to keep his shrubs in good vigor and flower. Spring blooming shrubs such as Forsythia, Weigelia, Van Houtte Spirea, Philadelphus are best pruned and thinned out shortly after flowering. This is because the plants bloom on stems developed during the preceding season. Summer and the few fall blooming shrubs such as crepe myrtle, Vitex and Buddlea bloom on stems developed during the current season and should be pruned, thinned and shaped in early spring.

Holly, long the plant symbol of the Christmas season, has become increasingly popular in midwest gardens. Many gardeners decline to prune their hollies at the Christmas season in fear of injuring their trees. American and English hollies can safely be pruned for Christmas decoration. Such pruning, if carefully done, will maintain the characteristic pyramidal shape of the tree and will stimulate the production of new shoots which will bear heavily the next season. The gardener must remember that among the hollies the male and female flowers are borne on separate trees. Berries are borne only on female flowered trees, provided male trees for pollination are close at hand (or within several city blocks).

Roses have been a popular summer blooming shrub of midwest gardens since colonial days and make an excellent subject on which the gardener may apply the pruning principles set forth in these paragraphs. Roses, because of a rather fast habit of growth, respond quickly to pruning, thus enabling the gardener to correct and perfect his technique within a short period. Roses of the hybrid-tea and florabunda type in general should be shortened to approximately eighteen inches about mid-November, to prevent strong winter winds from shaking the plant loose in the soil when the soil is extremely moist as during a winter thaw. Major pruning of these roses is left until the end of March, at which time it is safe to remove winter protection. At this time dead canes and those killed by winter injury are removed, and remaining stems shortened to 8–12 inches. All stems with a diameter less than that of a lead pencil are cut away. It is of utmost importance in pruning roses to maintain a very wide and spreading habit of the plant to facilitate later pruning, and to permit thorough coverage of leaf surfaces later in the season when the plants must be sprayed for insect and fungal pests. Such an open habit is easily attained, if the pruner will exert diligence toward cutting to a bud pointing to the outside of the bush.

Climbing or rambler roses may be pruned shortly after blooming. At this time all the canes should be cut to within two or three inches of the ground. Climbing roses bloom best on wood developed during the preceding season, hence cutting to the ground assures the gardener of strong, vigorous blooming shoots for the following season. The gardener will find it wise to reduce the number of shoots to about three or four of the very strongest, otherwise the canes will become too crowded on the trellis where there is great competition for light. Thus they will fail to develop abundant flower buds.

Pruning for Disease

Occasionally the gardener will find need to remove portions of branches or even the entire limb or shoot in the control of certain virus diseases or borer attacks. Such removal should be made at their first notice, cut back far enough to be certain all infection is out, and the removed portions burned on the trash fire immediately.

Pruning at Time of Transplanting

Almost every plant that is moved from its original growing site will need some pruning attention to balance the stem structure with the root system reduced by the process of digging. Plants dug with bare roots will need at least half of the branches removed, leaving only a well-spaced skeleton of main limbs. Balled plants will usually succeed if at least one-third of the branches are removed. Such pruning is gauged to insure quick recovery from the shock of transplanting and also to prevent die-back of limbs by reason of a reduced root system unable to support an overbalanced top. Can-grown plants generally should be left unpruned unless roots have grown through the bottom of the can, in which case the top will have to be brought into balance by removing branches to approximately half of the total length of roots lost. In most cases it will be found practical to cut off roots growing through the bottom of the can to facilitate removal of the plant without breaking the ball of soil encasing the roots within the can. Pruning of top for transplanting should be done at time of moving the plant and will generally be found easiest while the plant is out of the ground and can be maneuvered into handy positions for making precise cuts. Shade trees such as oaks, sweetgum and maples; conifers such as pine, spruce, cypress; and broadleaf evergreens such as holly and bullbay magnolia should never have the main stem cut back because the single straight trunk is essential for development of a stout, sturdy specimen in later years of growth.

Pruning for Storm Damage

Limbs and portions of limbs damaged by storm, or in other ways, should be removed to the trunk or cut back to the nearest branch immediately, and the cut painted to prevent possible infection. Prompt attention at any season will eliminate dangling members which could cause further injury to the remaining portion of the plant.

Pruning Shade Trees

Shade trees are generally pruned through the winter and into early spring. Absence of leaves renders it easy to observe the branching pattern, and also makes individual branches lighter in weight, thus reducing the hazard of stripping bark when limbs are cut for removal. It is wise to observe some few trees as exceptions to this rule. American and slippery elms and silver maple bleed badly if cut in early spring, and may continue to do so until mid-June. These trees are properly pruned about the end of June, or if in winter, not later than the end of December. Shaping-pruning, where limbs less than one and one-half inches are removed, or when dead limbs are to be removed, may be done at any season. It will be prudent to paint all wounds and cuts one inch or over with a wound dressing.

PRUNING TOOLS

Most home gardeners will be able to give their plants good maintenance with comparatively few tools. At least three tools are essential—a good hand pruner, a lopping shear (long-handled pruning shear) with twenty-four inch handles, and a curved pruning saw, having not less than eight teeth to the inch. Those having numerous trees may want to add to this list a curved blade pole saw and a pole shears and perhaps even fifty feet of one-half inch or larger rope, and a twenty-foot extension ladder.

Following are some considerations in selecting tools for pruning work. As with most garden tools, it is most advisable to purchase high quality tools for pruning, for good steel blades stay sharp and make neat cuts essential to rapid healing of wounds. Handles of pruning tools are under great strain and must be of high quality.

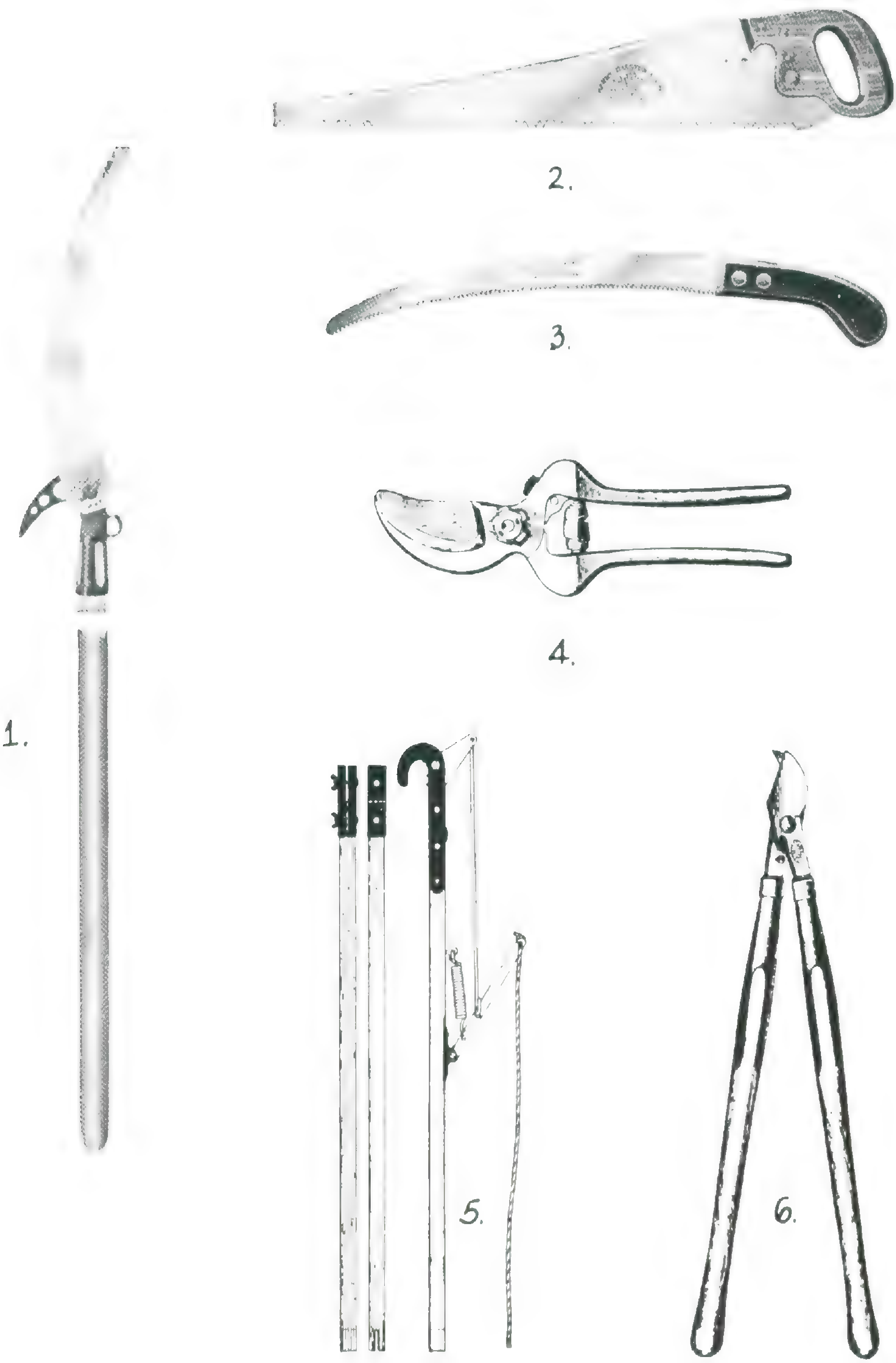
Hand Pruning Shear

For most gardeners the hand pruning shear is an indispensable tool. For general, all-around use, a shear having an overall length of about eight inches will cut the smallest twig and also fairly large branches. In using this tool, the gardener is warned against using a twisting motion as he cuts, for this can cause springing of the blade and result in failure of the tool to cut clean. The gardener is also cautioned against cutting larger branches of tougher woods with the hand pruner, for this task is more effectively accomplished with the lopping shear. Gardeners will find the type of hand pruner having a lock high on the grip near the pivot point easier to use. Those with a lock on the lower end of the grip often result in painful blisters on the palm of the hand.

Lopping and Pole Shears

For those having many shrubs and trees in their garden a good lopping shear is an important tool. This long-handled shear is designed for making cuts too heavy for the hand pruner. The pruner will also find it eliminates some stooping, and its long handles make it a handy tool for trimming low-hanging limbs from trees without the use of a ladder. As with the hand pruner, caution is required not to make a twisting motion when heavier limbs are cut, as this could spring the blades. Limbs that cannot be cut easily with the lopping shear should be left for the saw.

The pole shear makes a very handy tool for light shaping of trees and very tall shrubs. It must be remembered that the cutting capacity of this tool is very limited and does not exceed that of the hand shears. The pole shear has the distinct advantage of reaching those difficult branches impossible to reach with a ladder and hand or lopping shears.



Types of pruning tools as suggested in the text: 1. Pole saw; 2. Pruning saw; 3. Curved pruning saw; 4. Hand pruning shear; 5. Pole pruner; 6. Lopping shear.

PRUNING SAW

Though an ordinary carpenter's saw can be used in the pruning of large shrubs and trees, the gardener will find the pruning saw an easier tool to use. Pruning saws have a coarser set to the teeth. Some have teeth set to cut on both push and pull stroke, and will cut green woods much more easily than other saws. The gardener will find a narrow, curved-blade saw with fine teeth most handy for general pruning. Here one is warned against the use of certain narrow, straight-blade saws having fine teeth on one edge and coarse on the other. Such tools often cause serious injury to nearby limbs when working in close places. A large saw similar to the carpenter's saw, but with pruning saw set to the teeth, is very handy when pruning large limbs in trees. A pole saw having a curved, fourteen to eighteen inch blade mounted at the end of a ten to twelve foot pole is quite handy for tree work.

PAINT

It is standard practice among tree surgeons to paint wounds resulting from removal of limbs or accidental damage to bark to guard against infection of exposed wood by fungi and ravage by borers. For this purpose there are definite limitations to the sort of material used. The gardener is cautioned against using paints containing volatile thinners such as turpentine, benzol, etc. Asphaltic paints are recommended. Specially-prepared wound dressings can be obtained from reliable seed stores and nurseries, and would doubtless be the safest dressing to use. When paints containing volatile thinners are used, considerable importance lies in possible injury to the tender thin growing layer, cambium. This tissue will, in time, develop the natural healing scar covering the wound.

CARE AND MAINTENANCE OF PRUNING TOOLS

Like all sharp-edged cutting tools, the gardener's pruning tools will require regular and careful attention if they are expected to work efficiently, make neat and clean cuts so necessary for quick healing of the pruning wound. Immediately after use, tools should be washed clean of all sap and gummy residues with a stiff brush and water, dried thoroughly and well oiled to prevent rust. Tools used to cut away diseased portions of plants should be disinfected with strong alcohol to prevent possible infection of other healthy plants. Blades of pruning and lopping shears should be touched up regularly with an oil stone or fine file. However, only the beveled-edge blade should be so sharpened, the other unsharpened should never be touched. If the shears fail to make a clean cut or tear bark in cutting, the blade has probably been sprung by twisting the shears in cutting, or attempting to cut too large a stem. Sharpening of pruning saws should be left for the professional. The cost is nominal. Handles of pole saws, lopping shears and pole saws should be rubbed with linseed oil occasionally to keep the wood smooth and free from weather cracking.

HOW TO PRUNE

DESPITE the fact that many fine, well-illustrated books and pamphlets have been written on the subject of pruning, the gardener will draw his best lessons from his own garden if he will but take the time to closely observe each individual species and its peculiar manner of growth and blooming. Particular attention must be given to the arrangement of the bud, leaf and flower and shoot buds because these, as pointed out by Dr. Went, determine the type of growth the gardener can expect from the plant after pruning.

Among shrubs and trees commonly grown in gardens, there are two types of arrangement of the bud on the twig. These give origin to typical habits of growth of the plant. Basically, buds have either an alternate or an opposite arrangement on the twig. The gardener will find that a greater number of plants will have an alternate arrangement of buds. Such arrangement of buds accounts for more common habits of growth. Alternate budding usually gives rise to rounded, pyramidal, inverted pyramid, or columnar-shaped plants. Opposite budding rarely leads to anything more than a rounded shrub or tree with a rounded crown. Position of the last bud or pair of buds left on the twig will determine the direction in which the new shoot will grow. Buds on the top of the twig will probably grow upward at an angle. The bud on the side of the twig will grow outward at an angle, and to the side in which it is directed. In opposite budded plants, when the cut is made to a pair of buds in lateral position, both buds often grow. Observation of bud arrangement and care in selecting the terminal bud to be left, is of utmost importance in the development of shapely plants. Care in selection of terminal buds can also reduce much pruning work later on, if the pruner will exercise caution not to direct the bud and its potential shoot toward another branch where there is little light for growth and possibility of chafing of branches.

The gardener who would become proficient in the art of pruning must learn that the pruning task is not finished when the shears are washed, oiled and hung on the rack, and the brush disposed of. He must watch the buds left from his cutting expand, the shoot lengthen and mature to flower and fruit. From close regular observation he will learn his mistakes and how to correct them when the pruning shears are next taken in hand. He will also experience the supreme satisfaction of directing the course of nature in one of the few ways permitted to man.

Pruning for Shape

Often trees and shrubs send out a particularly vigorous shoot which, if left to continue growth, would spoil the appearance of an otherwise shapely plant. Such shoots can be safely shortened to proper length early in July. It is important that such shoots on spring-flowering shrubs be shortened in July to permit resulting lateral growth to mature and develop flower buds. In most cases, the gardener will find his hand pruner will

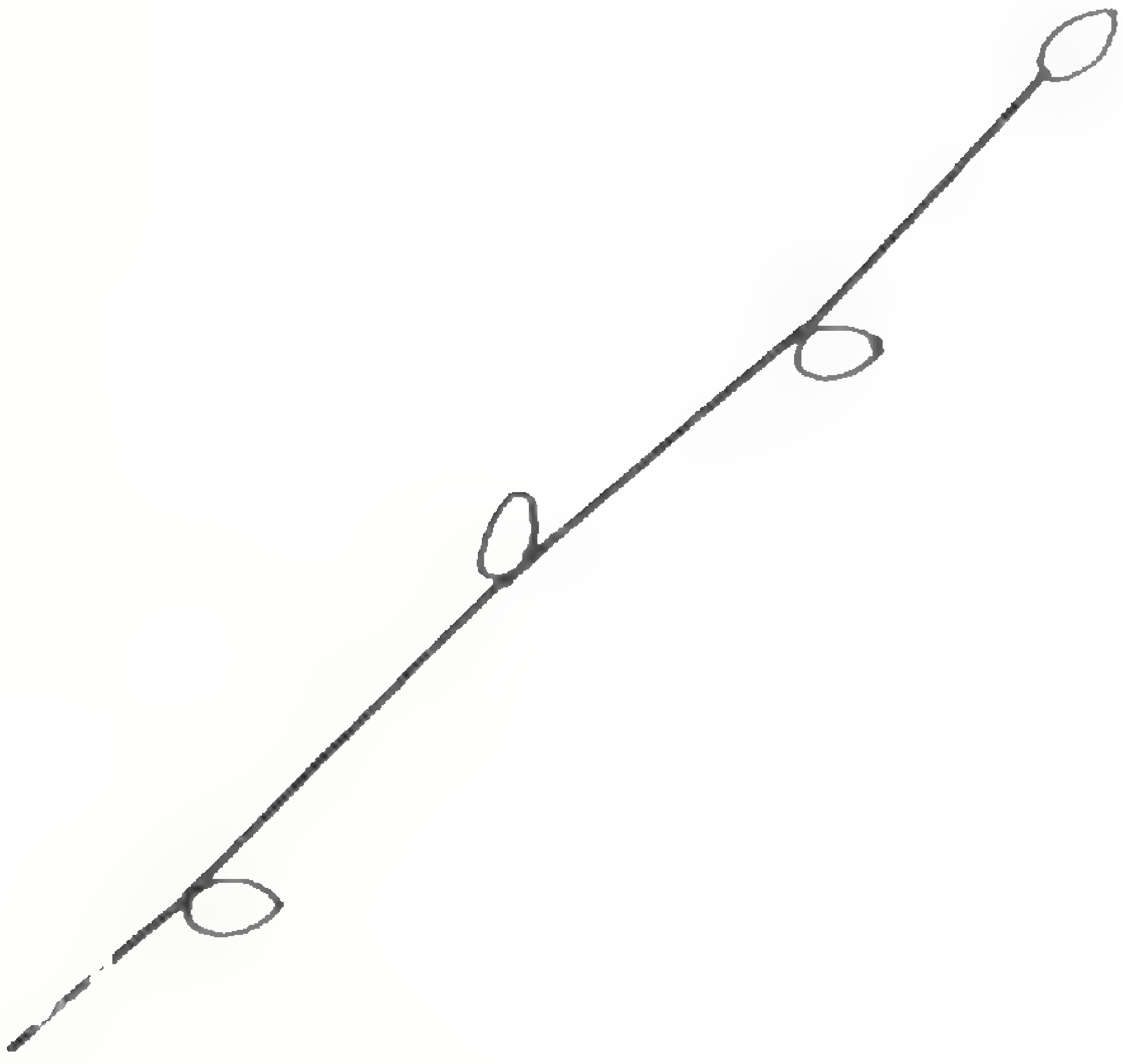


Fig. 1

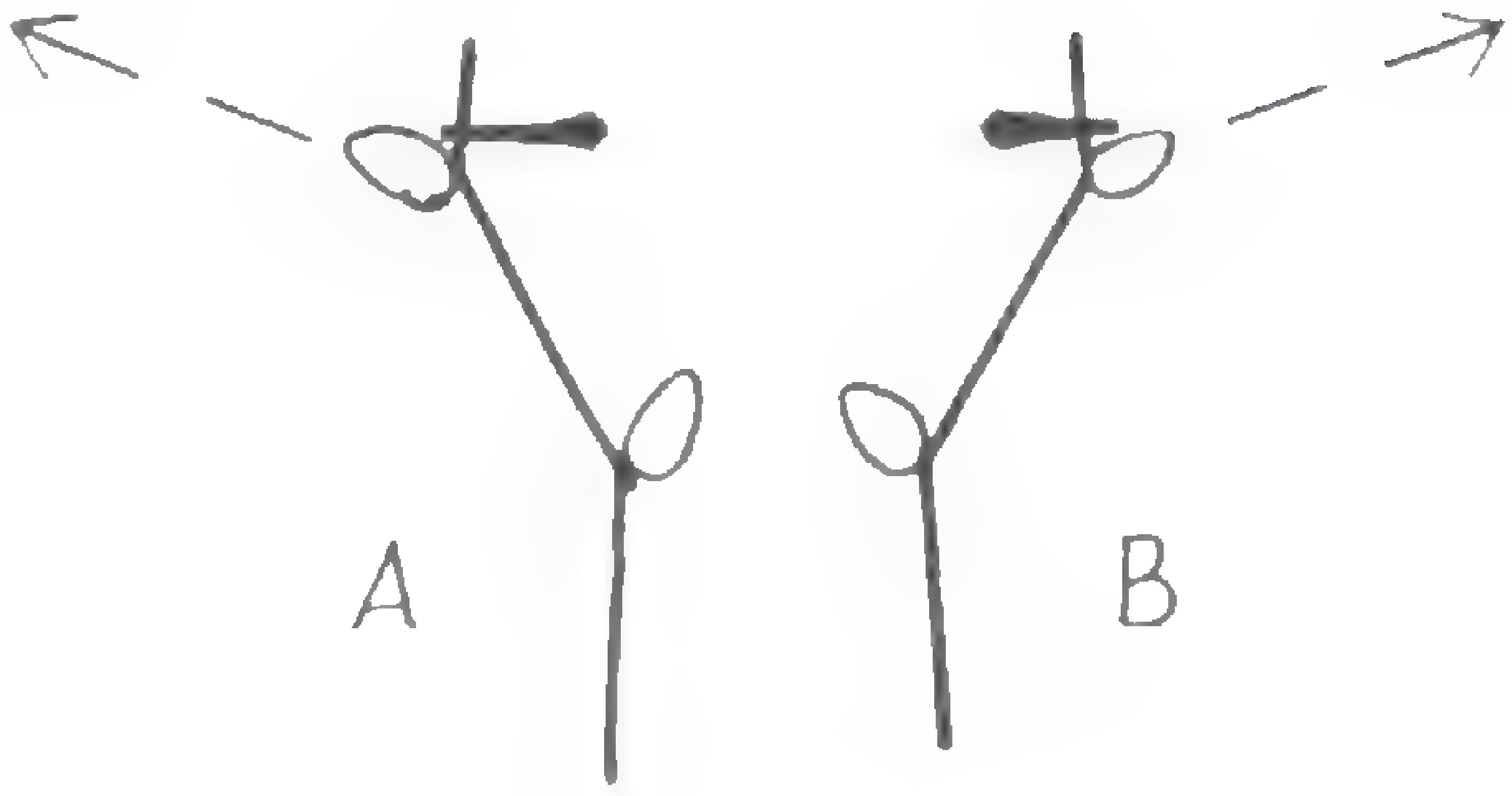


Fig. 2

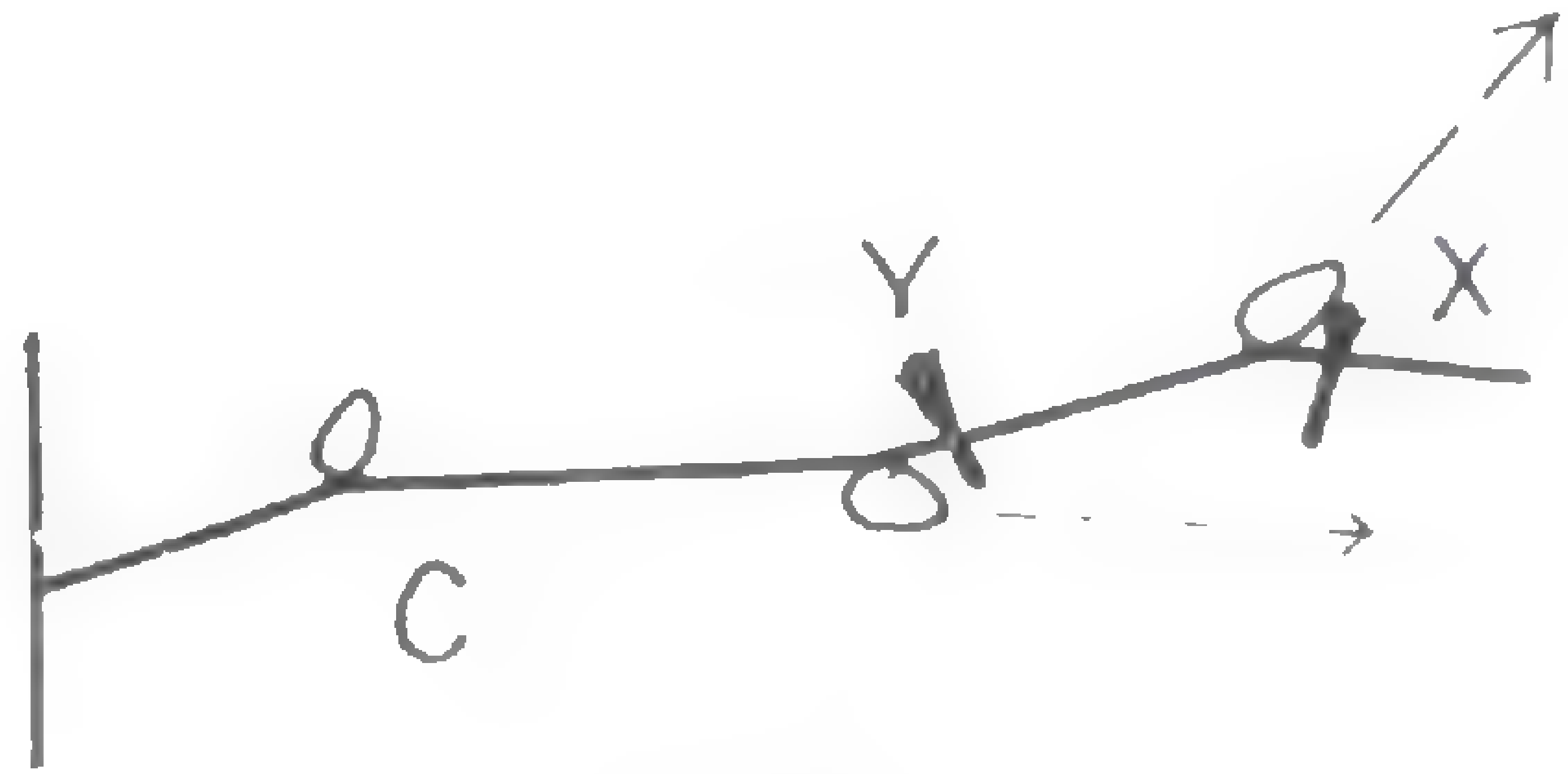


Fig. 3

Fig. 1. Typical stem with alternate buds. After pruning direction of growth is determined by position of bud immediately below cut. Fig. 2 A, B. Top view of alternate budded branch, shows pruning cut to direct growth right or left side. Fig. 3. side view of alternate budded branch, cut at "X" encourages growth out and up, cut at "Y" encourages horizontal growth, rarely down.

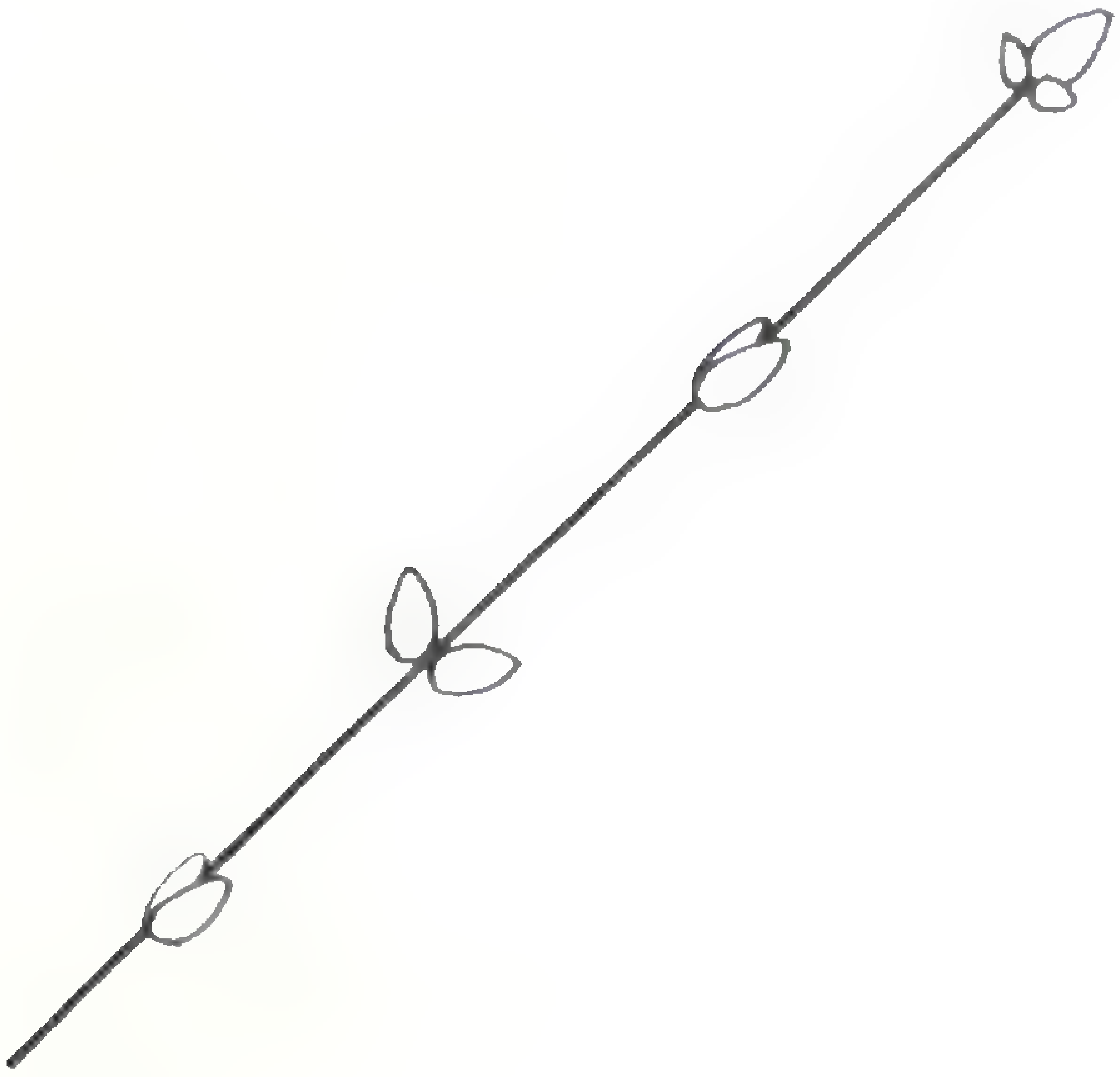
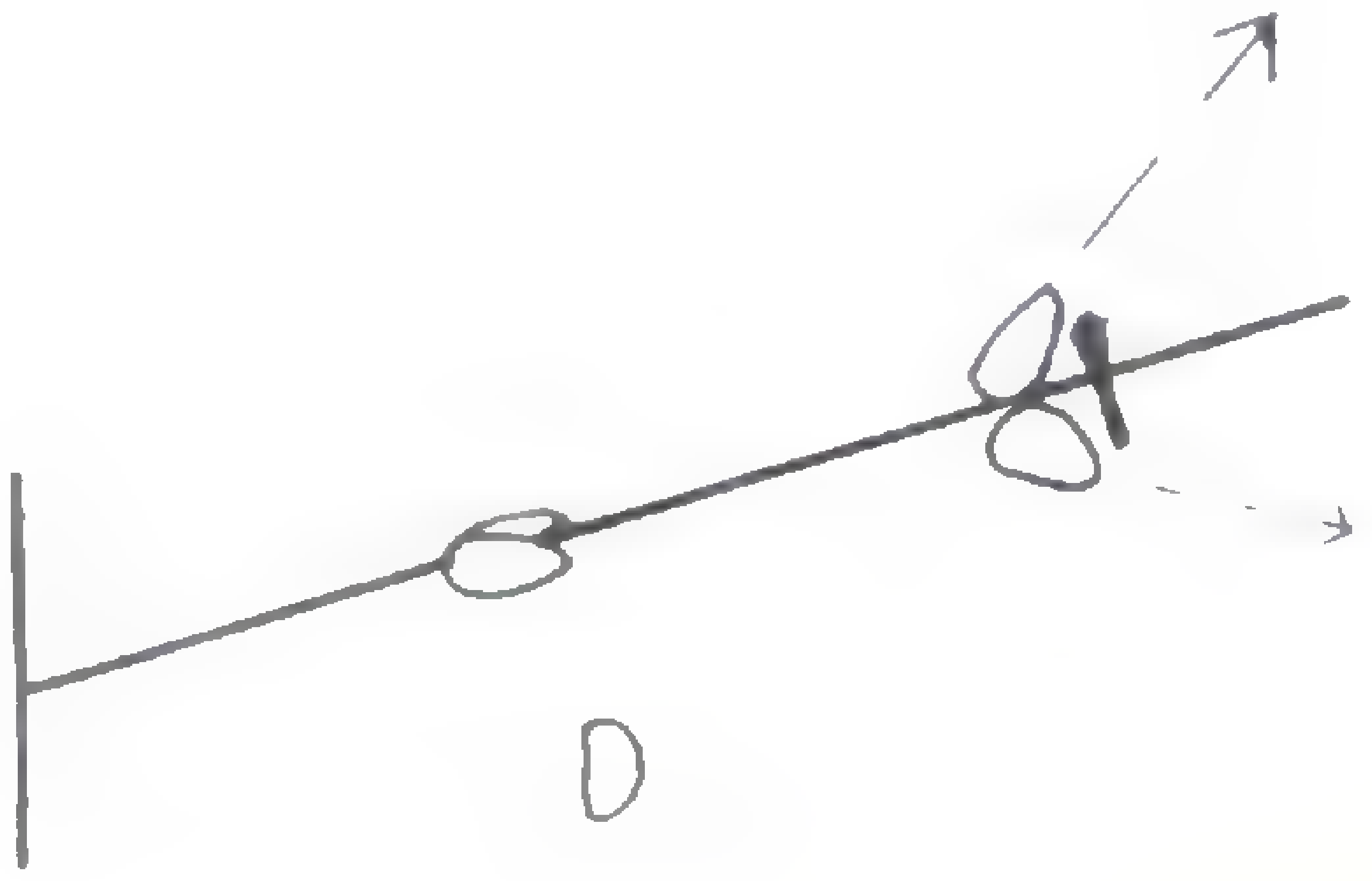


Fig. 4



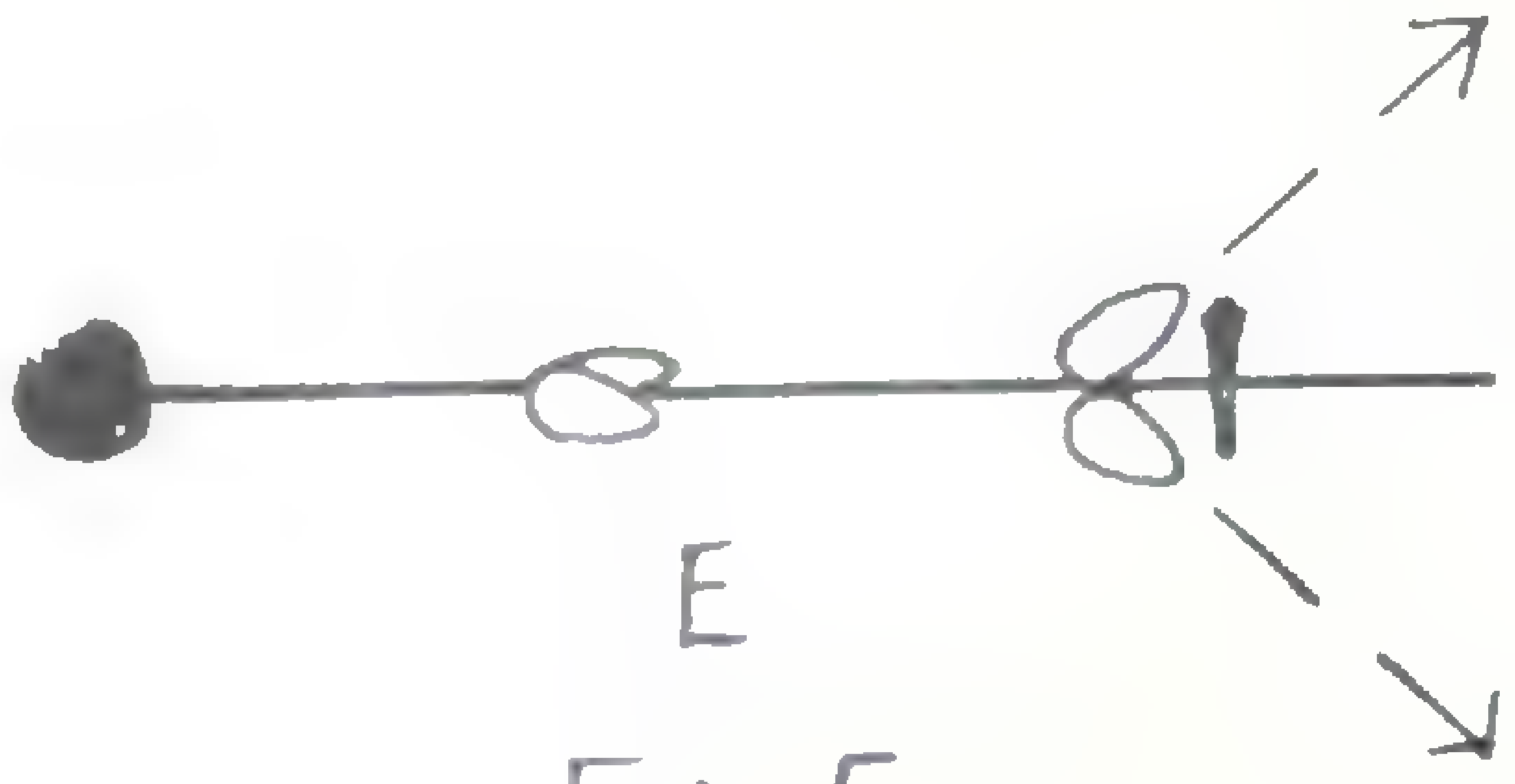


Fig. 5

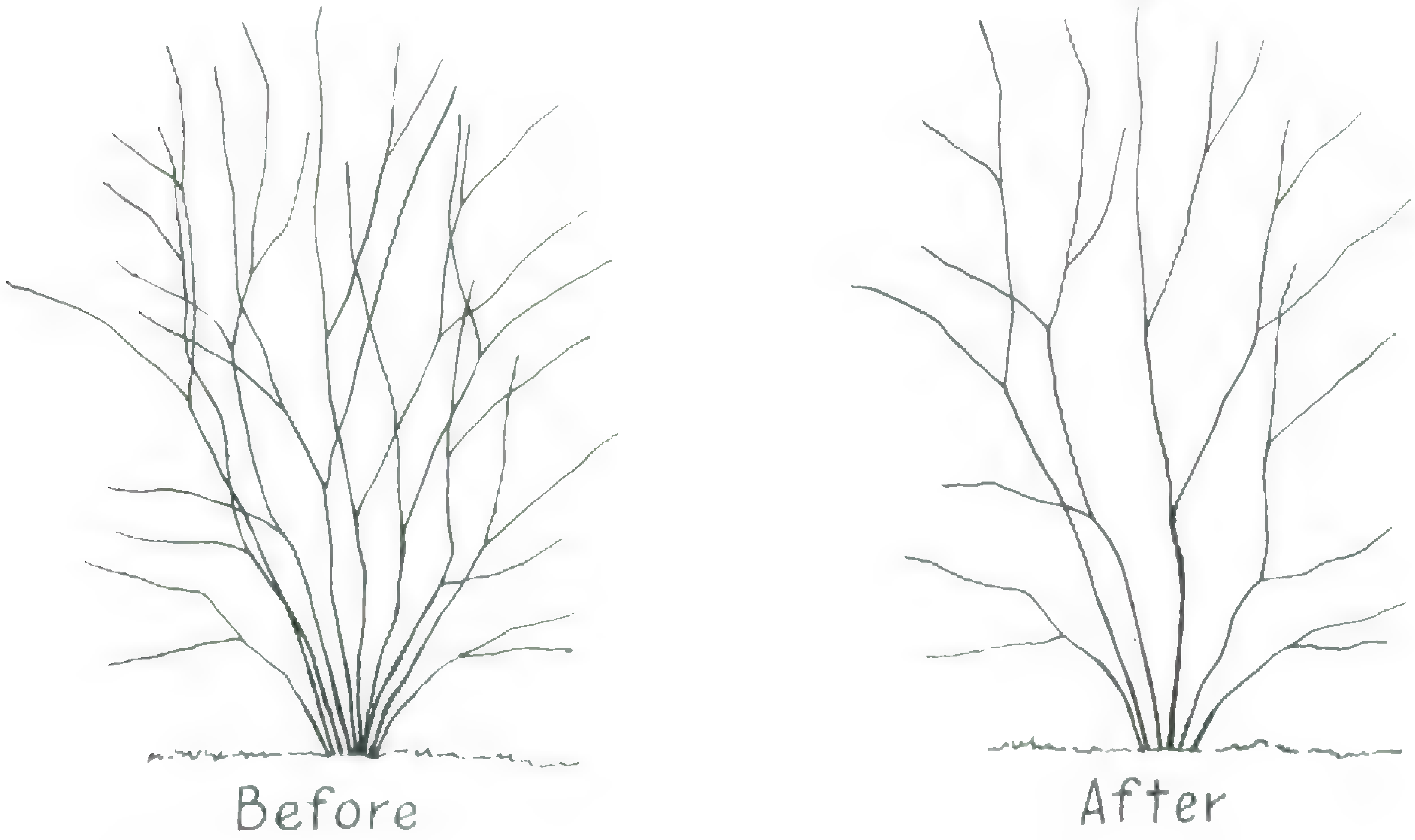
Fig. 4. Typical stem with opposite buds; note each pair of buds usually arranged at right angle to pair above and below on stem. Fig. 4 D. Side view of opposite budded stem, buds in vertical plane; top bud produces most vigorous shoot in out and up direction. Fig. 5 E. Top view of opposite budded stem, buds in horizontal plane; both buds usually grow at equal rate in horizontal plane.

perform this task, or for trees, the pole shear.

Shaping of evergreens, such as junipers, yews, arbor vitae, should be done in early spring, as the plants usually reach maximum elongation of the new shoot early in July. Pine, Spruce and Fir can be shaped by snipping off the tips of over-long branches in March or April. However, care must be exercised not to remove more than one-third of the total leafy area of any one limb.

Pruning for Vigor

Shrubs, more than trees, require pruning attention to maintain vigorous shoots, capable of producing abundant flowers. Most often, the gardener will find it most practical to remove old shoots to the ground level, using the lopping shear or small saw. Usually the third year after the shrub has been planted, and by each succeeding year, it is advisable to remove several older shoots to maintain a youthful, vigorous condition of the plant. Generally, the dark, heavily-barked shoots are old and produce few flowers. Such old shoots, because of their lack of vigor, are prone to attacks by borers, which may be attracted in sufficient number to bore into younger shoots as well. The pruning gardener should take advantage of the fact that most shrubs bloom best on young wood. Spring-blooming shrubs should be thinned quite harshly to force abundant new shoots to bloom the next season. Such cutting, of course, takes place soon after flowering. Summer-blooming shrubs receive similar treatment in early spring.



Before

After

Flowering shrubs should have old stems removed, remaining stems thinned out if necessary, to encourage young vigorous growth capable of producing abundant flowers.

In any case, the gardener should check his plants regularly, and when the new shoots reach about four inches they should be thinned to an even spacing to insure even light to all. Shoots cut to the ground are often replaced with four to five vigorous new shoots. The gardener will find it advisable to leave only one or two of the strongest, and these spaced about four inches apart. Attention to this detail will make future removal of old stems much easier, because they can be easily reached with lopping shears or saw without injury to nearby shoots.

Certain old shrubs that have gone without pruning attention for many years may be rejuvenated by removal of old stems over a period of at least two years. Such removals should be done in early spring.

Some spring-blooming shrubs, such as Forsythia, the gardener will find will bloom especially well if the entire plant is maintained in a quite open branch system to permit abundant light to reach the stems, in which case the plants often bloom over the entire length of the shoot.

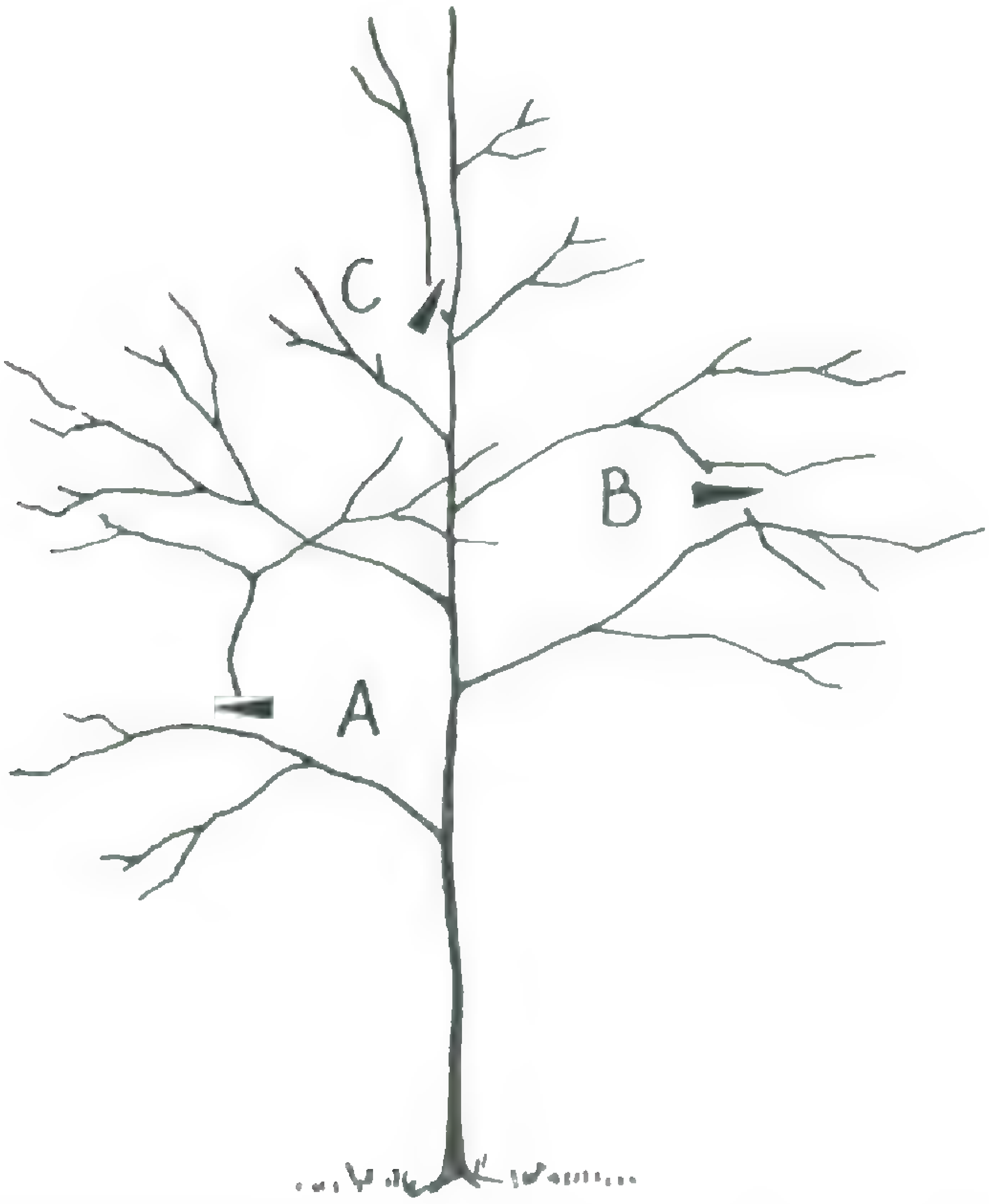
PRUNING TREES

Trees in general require less pruning attention than shrubs but, unlike shrubs, whose outstanding characteristic beauty lies in continual rejuvenation, trees gain beauty and majesty through age. The pruner, therefore, is cautioned that the effects of his pruning of trees is of long duration. Pruning of shade trees is most often directed toward development of strong, straight trunks with a well-spaced scaffold of limbs. Pruning should begin with the first season after the tree is planted. Early attention is directed toward development of the straight trunk without narrow crotches or "V"s. Branches are encouraged to leave the trunk at wide angles, as these prove strongest in strong wind and storm. In later years, as increasing numbers of limbs develop, attention is given to removal of limbs that grow toward the interior of the crown, and also those that lie across one another and chafe and rub.

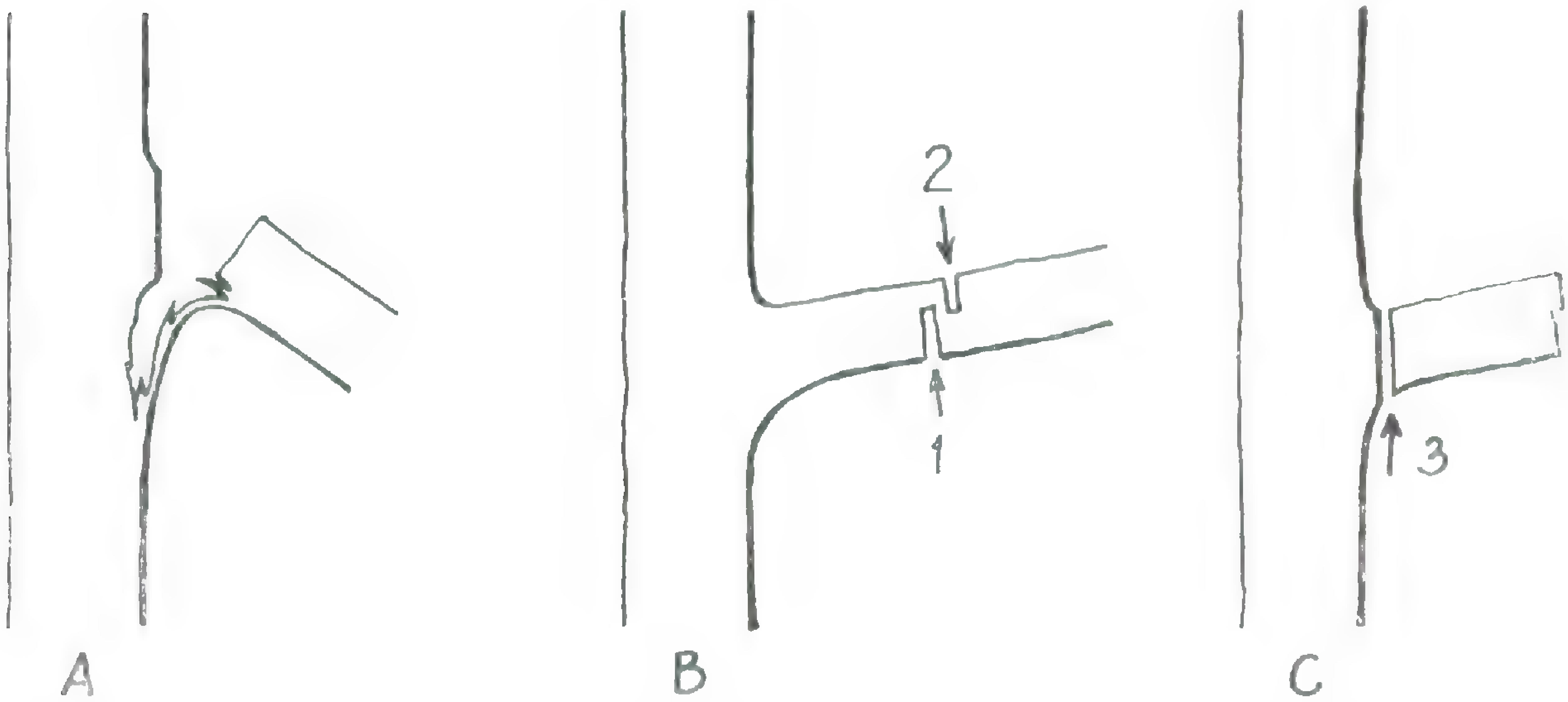
It is especially important that flowering trees, especially crabapples and hawthorne, receive corrective pruning when quite young, for major limb removal after the plant matures to blooming age, leads to development of numerous water sprouts (sucker shoots), which cause much additional pruning work, and if left unattended, most often ruin an otherwise shapely tree.

THE PRUNING CUT

In all pruning successful healing of the wounds resulting from the removal of limbs is directly related to the craftsmanship practiced in making the pruning cut. Healing or callousing of the wound is a function of the cambium layer (the thin green inner bark), and occurs quite rapidly on healthy plants when smooth cuts are made, as when a sharp shear or fine-toothed saw is used. Because the cambium has its greatest activity in the direction of the length of the shoot or branch, the gardener will observe that the sides of the pruning cut will heal faster than the top or bottom, and elongated wounds will



Three principal types of branches to remove in good tree pruning to insure strong shapely trees. A. Remove limbs that have growth directly into interior of crown. B. Remove limbs that rub and chafe another limb or show possibility to do so in later years. C. Remove secondary leader, also limbs that form narrow "V" crotch. Observe A. and B. in shrub pruning also.



To remove large limbs from trees. A. Shows incorrect procedure. Initial cut from top and close to trunk usually results in tearing bark from trunk. It is advised to remove limb with three cuts indicated in B. and C.

heal faster than the more round wounds. Also, for this reason, the cambium fails to heal over stub ends of branches when the pruning cut is made too far from the trunk or remaining limb. Proper places to make cuts for rapid healing of wounds is best described in the preceding diagrams.

Removal of large limbs presents a special problem in pruning, and the gardener will do well to follow a technique commonly practiced by most professional tree surgeons. Large limbs, because of their weight and length, exert a great pressure at the point of union with the trunk or larger limb. An attempt to remove such a limb with a single cut close to the trunk will invariably result in the limb breaking loose and tearing away bark immediately below, before the cut is completed, thus greatly increasing the area of the wound. Limbs more than one inch in diameter are best removed in several steps. First, the outer third of the limb is removed with lopping shears or saw. Next, two consecutive cuts are made near the trunk. These may be about four to six inches from the trunk for limbs one inch in diameter, and proportionately further out for larger limbs. The first of these cuts is made on the underside of the limb and through at least one-fourth of the diameter. The second cut is made on the top of the limb and slightly further out, away from the trunk. The pruner continues to saw this cut until the limb falls free, which it will do without tearing bark.

The remaining stub, now greatly reduced in weight, can be sawed away, making the cut from the top and as close as possible to the trunk. In this manner the gardener will experience slight, if any, tearing of the bark. The wound, of course, is painted immediately.

RECOMMENDED READING

The Pruning Manual, Everett P. Christopher, the Macmillan Co. 1954.

Shade Tree Pruning, A. R. Thompson, Tree Preservation. Bulletin #4, National Park Service, U. S. Gov. Printing Office. 1955.

Section on Pruning in the Standard Cyclopedia of Horticulture, L. H. Bailey, the Macmillan Co. 1928.

* * *

MISSOURI BOTANICAL GARDEN PROGRAMS

SPECIAL Shows and Displays in the Floral Display House:

Orchid Show, January 23 to February 28.

African Violet Show March 5 and 6.

Free nature program for children, seven to ten and eleven to eighteen years, are held every Saturday morning from 10:00 to 11:30 A. M.

The Mystery of the Orchid	February 6
Color Sound Movies	February 13
Plants in a Capsule	February 22
Three Cheers for the Green Thumb (you can take your plants home)	February 27
The Story of the Pin Cushion Forests	March 5
The Life Secret of a Plant	March 12
Make Your Own Dwarf Gardens	March 19
Color Sound Movies	March 26

Free summer programs of nature study for children are supported by a gift from the Pitzman Foundation. Trails, craftwork and group activities are offered. Schedules for these programs may be obtained in June from the Main Gate.

COURSES

The following courses are open to any interested person. Certificates are awarded upon successful completion of any course. Information on registration may be obtained by calling PROSPECT 6-5567.

Please send all registration fees to

Missouri Botanical Garden
2315 Tower Grove Ave.
St. Louis 10, Mo.

HORTICULTURE

Course 122. Spring Horticulture.

Place: Museum Building.

Time: (Register for only ONE of the sections offered.)

Section I, Wednesday afternoon 1:00–4:00 P. M. March 16, 23, April 6, 13, 20.

Section II, Friday morning 9:00 A. M.–1200 Noon. March 18, 25, April 8, 15, 22.

Section III, Monday afternoon 1:00 –4:00 P. M. March 21, 28, April 11, 18, 25.

Section IV, Tuesday nights 7:00–10:00 P. M. March 22, 29, April 12, 19, 26.

Fee: $18.00 for five meetings.

Enrollment: Each section is limited to 20 students. Please register early.

This course will teach beginning gardeners how to propagate plants from seed. Special emphasis is placed on annuals and perennials. Each section will include a lecture period and a practice period. The lectures will discuss factors effecting plant growth and practical means for control, such as optimum supply of heat, light, moisture, air, fertilizer, lime, mulch, pest and disease control. Each student will receive seeds and four metal flats with sterilized soil. There will be enough space to grow 300–350 seedlings which, with the flats, may be taken home. Seeds of those plants particularly desired by a student should be brought to the first session.

Instructors, Mr. Clarence Barbre, Mr. Kenneth Peck.

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Trifon von Schrenk	Associate Curator of the Museum
Robert E. Woodson, Jr.	Curator of Herbarium

SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at TOWER GROVE, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the TOWER GROVE mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. spring to fall and until six in the winter time though the greenhouses close at five. TOWER GROVE, itself, Mr. Shaw's old country home, is open from one until four, admission fifty cents, with special guides. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one most used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southhampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 A. M., but is closed on Saturdays, Sundays, and holidays. The Cleveland Ave. gate, 2221 Tower Grove, is nearly always open, and there is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., State Highway 100 adjacent to Interstate Highway 44. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.

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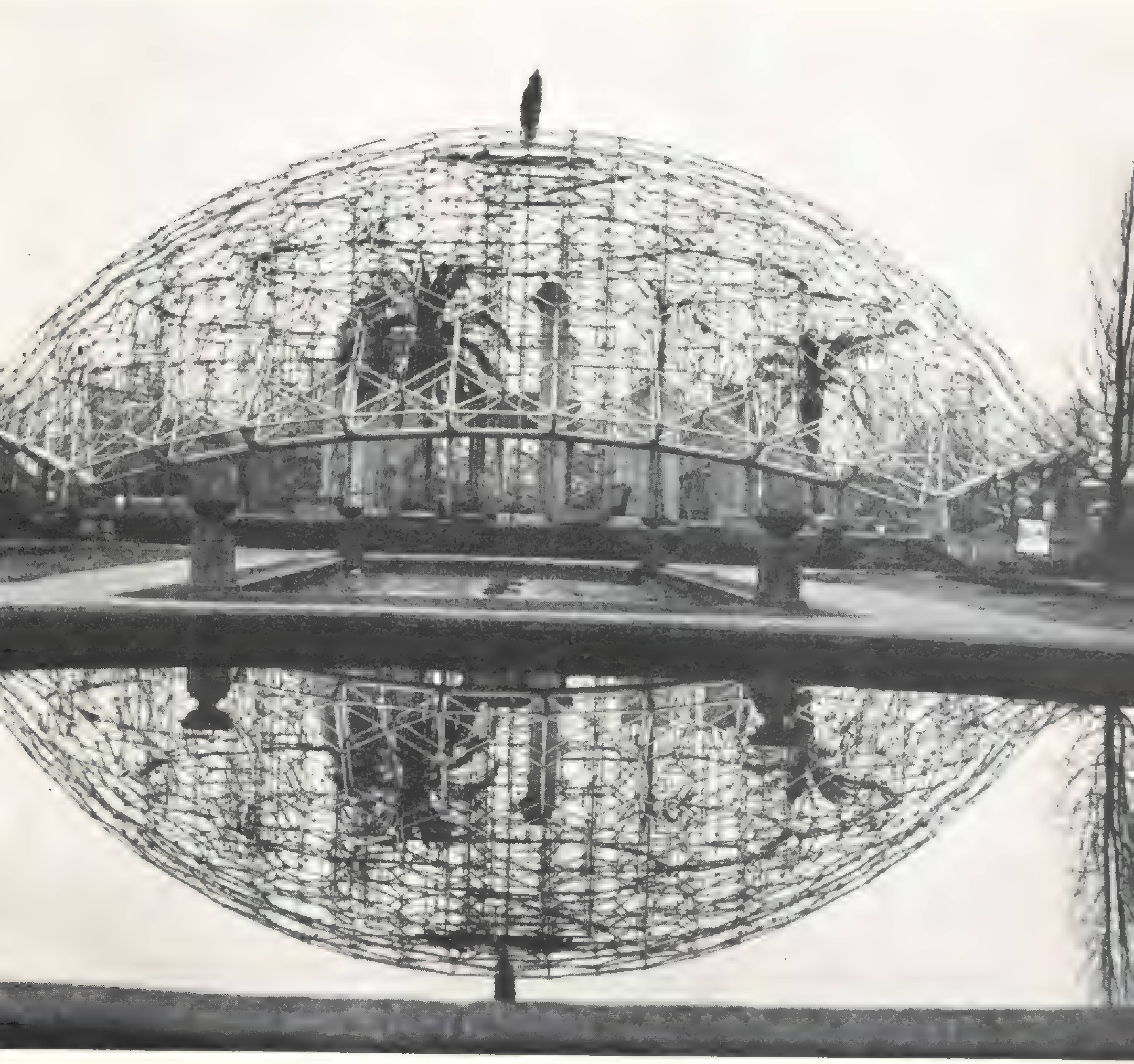
Number 3



THE MISSOURI BOTANICAL GARDEN
CENTENNIAL YEAR 1959

Cover: The framework of the new Climatron as reflected in the center lily pool. Photo by Howard Vogt, *Globe-Democrat* Pictures.

The evergreen tree atop the new Climatron is a salute to an ancient construction tradition. About 1300 years ago the custom of using an evergreen tree to mark the "topping out" of a building was originated in Northern Europe. When attached to the ridgepole the tree announced the completion of the frame without accident. Other countries adopted the custom, though the tree was often replaced by such diverse items as a wreath with ribbons, a tree branch, bull's horns, a sheaf of corn, a bunch of flowers, a bright handkerchief or a flag—some of which were reputed to bring good fortune and protect the building from lightning or from evil spirits.

The new and very modern Climatron bows gracefully to this old tradition.

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Missouri Botanical Garden Bulletin

Vol. XLVIII No. 3 MARCH 1960

THE MISSOURI BOTANICAL GARDEN IN THE CENTENNIAL YEAR

1959

F. W. WENT AND HUGH C. CUTLER

The plans for rebuilding of much of the physical plant of the Missouri Botanical Garden, announced in last year's report as essential for rehabilitation of this century-old institution, started to take concrete shape in 1959. This hundredth year of its existence was celebrated by the Garden in many different ways, but the major feature of the Centennial Year was undoubtedly construction of the first unit of the new greenhouses, the Climatron.

As mentioned in this report, the Fern and Economic houses, flanking the monumental Palm House, were physically in such bad condition that they could not be repaired further, and complete reconstruction was indicated. Even the Palm House itself would have needed such extensive rebuilding that its cost would have been prohibitive. And these houses, which were modern half a century ago, could certainly not have been sufficiently changed to make them acceptable by 1960 standards. Therefore the Board of Trustees made the decision to replace these three houses with a new structure, which should be the last word in greenhouse construction, and which should have at the same time a dramatic appeal to highlight the new policies of the Garden.

In considering all aspects of the reconstruction problem, Mr. Eugene Mackey of the Architect firm of Murphy & Mackey, which had been retained to do the planning of the new greenhouse, decided that a geodesic dome, as invented by Mr. Buckminster Fuller, would best fulfill all requirements. This structure is the most economical for a building unsupported in the center; it has the smallest surface for its volume, and it offers very interesting possibilities for enclosure and for growing space.

It was originally hoped that the new greenhouse could be erected so rapidly that it would be completed in time to protect the large palms which were left standing upon demolition of the old palm house. In spite of the fact that construction was speeded up as much as possible, factors beyond anyone's control delayed completion of the new greenhouse, of which the framework was already completed by January 1, 1960. When the old Palm House was torn down it was found that the steel beams were in much poorer shape than had been thought, and that reconstruction of the old house would have been almost impossible without replacing every steel girder.

Originally it was intended to enclose the whole Climatron with plastic sheeting suspended from the alumnum framework. However, it was decided that such a plastic skin, although feasible, would not have been very durable using the presently available plastics, and therefore a completely new enclosure was designed, with triangular plexiglass panels mounted with neoprene gaskets in an aluminum framework. This will give a very high degree of light transmission, allowing, even in winter, a fair amount of photosynthesis in the plants growing inside. The light intensity will be at least double that which prevailed in the old Palm House.

The planning, to be modern, had to include air-conditioning of the new greenhouse and had to prevent the development of excessively high temperatures inside. In ordinary greenhouses the temperature can be kept down during summer only by shading, which defeats one of the main purposes of a greenhouse, namely, to keep plants in the strongest possible light. Cooling can be accomplished in several ways: by refrigeration and by evaporation. Since the Climatron is to house tropical plants, it is sufficient to cool the air by evaporation, which is the simplest and most economical way, although the temperature cannot be lowered under 80° F. in summer.

The size of the Climatron, larger than any greenhouse previously air-conditioned, posed several new problems never encountered before. With the aid of Mr. Paul Londe and Mr. Arthur Hess, a completely new principle was worked out for the temperature control of the Climatron. Instead of trying to maintain an even temperature throughout the 23,000 square feet of the greenhouse, which would have meant enormous ducts and difficult problems of air circulation, a deliberate temperature gradient is to be produced and maintained. The air, cooled or heated to the desired temperature through water sprays and a water curtain, will enter the greenhouse at the west end. The existing topoggraphy suggested a solution, by which the water curtain could be located in a number of bays under the concrete bandslab on which the geodesic dome was to be constructed. This meant that the exhaust fans had to be located on the east side of the building.

During night the Climatron will need heating, and this is to be accomplished by an entirely different and separate air circulation system, also producing a temperature gradient but this time from south to north. The existing tunnel for the heating pipes could be used as an air duct for the warm air, to circulate it through the whole greenhouse. In this way two different gradients will be maintained in the building, an east-west gradient during the day, and a south-north gradient during the night. The size of the greenhouse should make rather smooth gradients, and thus a number of different climates will be created and maintained. On this basis the name of "Climatron" was selected for this greenhouse.

The structural and operational details of the Climatron are unique. Also its planting pattern is designed to be different. Instead of growing specimen plants, the intention is to grow several associations, such as an Amazonian jungle and a mountain rain forest. In this way the Climatron will not just be a display greenhouse, but it will also be used as a research tool, to study problems of tropical ecology, and to establish the optimal climatic requirements of many tropical plants.

In several other respects is the Climatron unique. In March, 1959, Mr. Mackey started to draw detailed plans of its construction. In May the plans had reached a stage when fairly accurate estimates of its cost could be prepared. The Trustees then made the decision to start construction immediately. New funds had to be collected, since the will of Henry Shaw provided only for funds for maintenance of the existing facilities. As these new funds became available in a wave of generosity of the Trustees personally as well as many business concerns and private citizens, precedented only by the original gift of Henry Shaw, contracts for demolition of the old greenhouses, for construction of the concrete base for the geodesic dome, for construction of the dome itself, for installing the plexiglass cover, for electrical installations, and for the heating cycle, were signed. Thus the building grew as the architectural and mechanical drawings were being completed, and as the funds were collected in a spirit of enthusiasm and faith in designers and providers, probably unequaled in building history. This is all the more remarkable because of the great complexity of the building, which under ordinary circumstances might have taken a year to design. But such is America—and especially St. Louis!

The summer and autumn months were exciting, as concrete and aluminum framework rose, and on November 19 a tree was attached to the top of the aluminum dome, indicating completion of the framework without any accidents to the workmen.

In the meantime much work was carried out by the Women's Association of Shaw's Garden in preparation for a Centennial Celebration which took place from September 26–October 4. The late Mr. Emil deLeuw coordinated their activities with the Garden operations, and by September an ambitious program of activities was lined up. The part of the Garden in the Centennial Celebration is mentioned separately; here only the activities of the Women's Association under Mrs. Kirkbride will be mentioned. It had been decided that a sales fair was to be held, and to this end four large tents were erected on the lawn east of the Shaw Tower Grove residence. One of the tents served refreshments, and was staffed from 10:00 A. M. to 10:00 P. M. Thousands of "hot dogs," cups of coffee, doughnuts and bottles of pop were sold to the visitors, who could sit under the big elm tree or on the lawn in front of the residence. In other tents a "White Elephant" sale drew thousands of people, buying anything from garden furniture to paintings.

Most articles for sale had been supplied free of charge by local firms and by private people, and were being sold by members of the Women's Association from 10:00 A. M. to 4:00 P. M. Also, rides through the Garden were available in Fiat cars loaned by a dealer.

In a special music tent, erected northwest of the Shaw residence, Miss Beulah Schacht had arranged for musicians to play and sing, both afternoon and evening. This was tremendously popular and it is evident that we should arrange for frequent outdoor concerts by small groups during the summer months, so that visitors may enjoy quiet music in harmony with the setting of a country garden of a century ago.

The Garden itself had also prepared for the Centennial. The lawns in the Knolls were better than they had been in years, through improved care. The water lily pools were beautiful. The rose garden was in full flower through proper care by the grounds crew and volunteer helpers who cut off the old flowers. The Linnean Garden was past its prime, but chrysanthemums and petunias still provided a lot of color. The flower beds along the water lily pools had been planted with colorful foliage plants, which in other years were used in the Italian Garden, now largely destroyed through building activities. And in between, gladiolus, donated by the Kroger Company, flowered. Perhaps most outstanding were the dahlias and chrysanthemums, which members of the Dahlia and Chrysanthemum Societies had planted in spring. They formed large masses of color along the Knolls.

It had been decided to keep the Garden open until 10:00 P. M. during the Centennial Celebration. This was so popular that almost as many visitors passed through the turnstiles at the main gate after 5:00 P. M. as were counted from 9:00 to 5:00, a good indication that, during summer, we should make a definite effort to have the Garden open at least several evenings each week. This means extra guards and proper night lighting, but obviously a large number of people like to come after work in the evening to enjoy an hour of quiet in beautiful surroundings. During the Centennial lighting was provided by 100 flares and about 100 oil wicks floating in small glasses, placed along the water lily pools.

The total attendance during the 9-day Centennial Celebration was 45,000 persons who entered through the turnstiles of the Main Gate, and an estimated 25,000 entering through the Cleveland Ave. Gate. Never during its entire history have such crowds visited the Garden. During the most active years of the Garden (1928–1938) only twice did a larger number visit it during a whole month (November, 1929 and 1934), but the Centennial attendance occurred during only a 9-day period, of which several days were so rainy that only the most enthusiastic garden-lovers came (during two nights there were tornado warnings). This shows that the Missouri Botanical Garden commands interest, and that the rehabilitation program is completely justified from a civic point of view.

During the Centennial there was an

exhibit of flower paintings by school children of the State of Missouri, held in the Museum. These paintings were sent in as the result of a competition and the quality of the art work was highly encouraging, so much so that we feel that this competition should become an annual event. In the three divisions, the prizes went to:

Class I—As the Artist Sees the Plant.

First prize—Annette Barkey, Jennings Senior High School.

Second prize—Rose Marie Bandl, Beaumont High School.

Class II—As the Botanist Sees the Plant.

First prize—Jerrily Rodden, Concord Lutheran School.

Second prize—Sylvia Treglown, Buder School.

Class III—As the Botanical Scientist Sees a Plant.

First prize—James Orton, O'Fallon Technical High School.

Second prize—Stephanie Stromdahl, Hamilton School.

On October 16–17 the now-traditional, annual Systematics Symposium was held. A total of 216 botanists and students from colleges and universities all over the Mid-West participated, and the discussions were as animated as usual. Discussion leaders were Dean Henry Andrews and Professor Bryan Patterson. The speakers discussed problems of Biogeography, both in general terms and specific cases.

The Tower Grove house of Henry Shaw, which had been partially restored in 1953 was, during 1959, brought back to its prime condition, and is now very much like it was in the days when Henry Shaw lived there. The Board of Trustees appointed an Historical Committee, consisting of Mr. John S. Lehmann, Chairman, Mr. Henry Hitchcock, Mr. John Bryan, Mr. Charles van Ravensway, Mrs. Neal Wood and Mrs. Edwin R. Culver, which has been put in full charge of the Shaw House. Mrs. Culver and Mrs. Wood, with the special advice of Mrs. Fothergill Graves, were most active in the restoration. The dining room, which had been occupied by the Iris Society, was re-furnished after Mr. Benson of that Society moved into one of the second floor rooms. The third bedroom, which had been occupied by Mr. Evinger, was also re-conditioned, and the ground floor quarters were re-done, and Mr. Evinger now occupies that area. Many of the pieces of furniture were re-upholstered, and the whole house now gives the impression of care and quiet elegance, just as it must have done in Henry Shaw's day.

The restoration was completed just prior to the Centennial, and over 10,000 people visited the house during the 9-day period. The admission fee was raised from twenty-five to fifty cents for adults, children still being admitted free when accompanied by an adult. This increase did not seem to affect the total attendance.

Hostesses for the Shaw House were provided as in the past six years by the Eighth District Federation of Women's Clubs of Missouri. Ladies from the Women's Association of the Garden provided refreshments and acted as hostesses for the Orchid and Chrysanthemum show previews.

In the years before 1953 the monthly attendance figures for the Garden were published in the BULLETIN. This is now being resumed, with the monthly attendance data for the last thirty-five years summarized in the following table, and the total yearly attendance shown in the form of a graph:

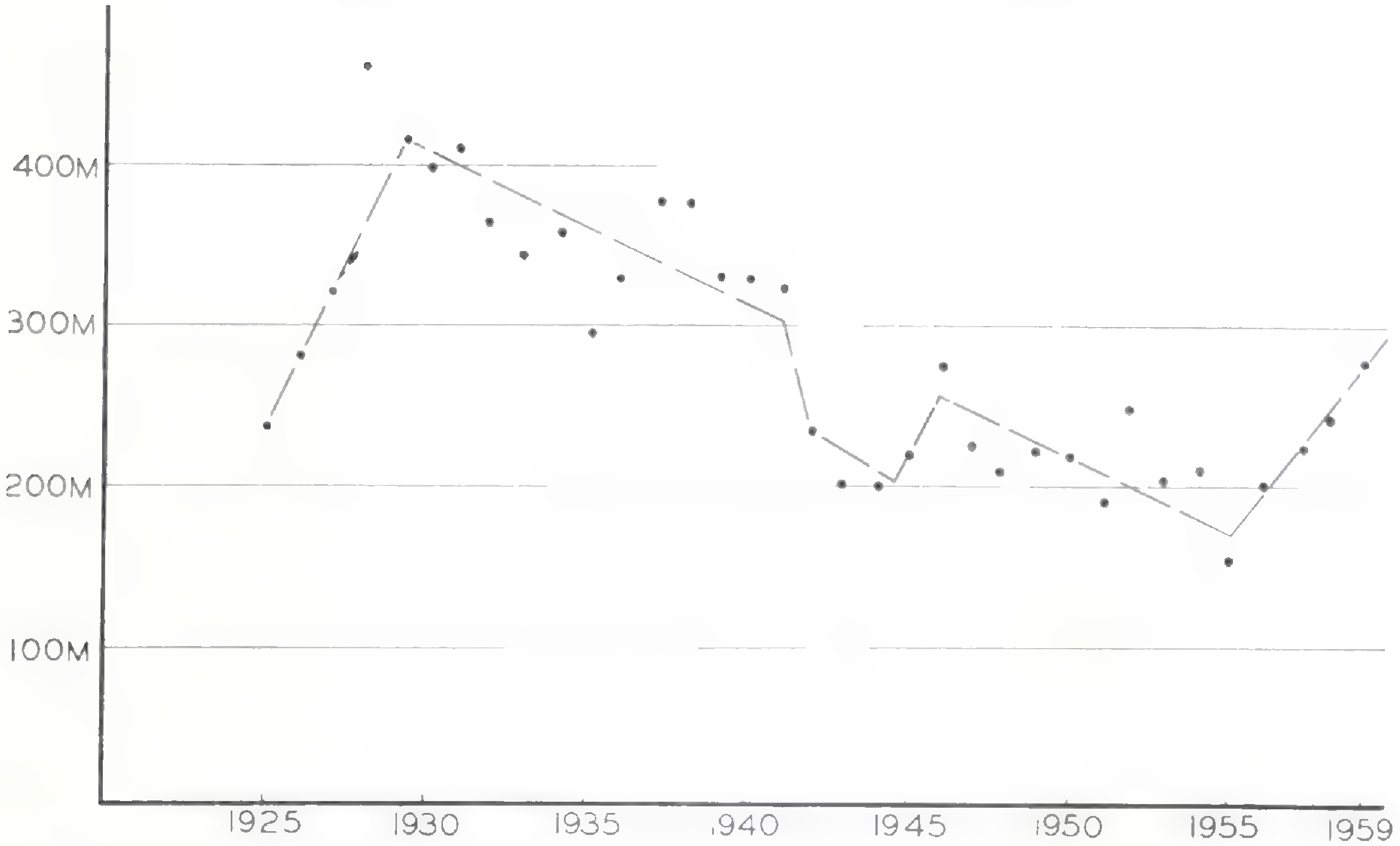
ATTENDANCE RECORD 1925 TO 1959

Shown in Thousands

	1925	*1926*	*1927*	*1928*	*1929*	*1930*	*1931*	*1932*	*1933*	*1934*	*1935*	*1936*
Jan.	7.4	23.5	9.4	16.8	9.3	13.8	27.4	30.2	29.1	11.4	7.3	10.9
Feb.	6.5	24.0	21.5	27.2	28.2	20.0	23.3	16.7	15.0	22.9	9.1	6.0
March	13.3	8.3	32.5	66.6	46.6	51.3	42.6	29.0	18.7	19.2	16.1	27.3
April	17.4	14.6	25.6	25.8	29.6	29.5	33.9	27.9	23.7	34.2	28.1	36.8
May	26.3	34.0	25.2	35.1	35.9	35.4	49.1	45.4	32.6	20.5	30.3	43.8
June	17.7	27.8	26.1	46.3	35.6	31.1	27.2	25.6	21.4	21.1	27.6	26.7
July	19.4	27.3	26.6	30.4	32.8	25.6	26.5	27.5	27.0	21.1	24.4	22.1
Aug.	41.6	32.4	31.2	42.3	43.9	34.9	38.5	33.9	35.6	25.9	31.1	32.6
Sept.	16.0	21.4	23.0	39.5	33.5	40.5	30.6	29.4	23.2	30.1	36.4	25.3
Oct.	15.7	23.1	20.4	38.4	35.2	38.6	40.6	42.8	27.9	47.0	28.3	36.7
Nov.	53.5	39.0	50.2	67.6	78.9	60.4	58.0	51.0	68.7	79.6	48.0	47.3
Dec.	5.7	11.0	12.9	32.0	14.1	11.8	18.9	10.8	29.1	15.5	16.3	22.1
YEAR	240.4	286.2	304.6	468.1	423.5	392.6	416.6	370.4	351.8	355.0	303.1	337.6

	1937	*1938*	*1939*	*1940*	*1941*	*1942*	*1943*	*1944*	*1945*	*1946*	*1947*	*1948*
Jan.	6.8	16.1	12.3	11.0	13.7	13.5	7.1	15.5	6.0	8.3	5.3	3.2
Feb.	22.8	35.8	29.2	15.4	16.5	7.8	13.4	12.3	12.8	13.0	18.5	11.6
March	33.6	28.0	18.4	24.4	16.1	17.6	10.4	7.4	12.8	20.4	12.0	15.5
April	21.1	32.8	27.2	20.7	28.1	23.9	18.6	22.8	25.6	27.1	25.8	18.1
May	52.6	42.0	38.2	42.3	40.7	31.7	26.3	20.1	23.1	25.2	33.6	26.2
June	32.9	33.9	23.0	31.5	31.5	22.1	14.6	17.5	14.7	22.1	21.6	17.6
July	35.6	30.0	29.1	29.6	34.0	23.0	17.1	19.8	18.0	21.8	22.3	19.9
Aug.	42.7	31.5	36.0	35.2	41.4	28.1	19.1	17.8	19.4	24.2	18.3	23.5
Sept.	31.0	27.3	25.6	32.6	32.4	20.3	15.8	21.7	21.5	44.4	19.0	20.3
Oct.	34.7	39.0	31.7	36.3	29.7	21.8	20.8	24.4	23.6	21.2	19.2	22.5
Nov.	59.2	50.3	46.7	41.0	37.4	24.1	30.0	25.5	36.3	37.2	32.7	25.7
Dec.	10.8	18.0	19.5	13.9	10.0	4.3	8.1	7.1	8.5	8.8	9.6	12.2
YEAR	384.0	384.6	336.9	334.2	331.4	238.2	201.8	201.9	222.3	273.7	235.7	216.4

	1949	*1950*	*1951*	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*
Jan.	4.5	6.5	5.7	9.4	4.5	14.1	7.9	3.8	4.3	5.2	5.3
Feb.	17.0	10.2	13.6	14.9	20.1	12.9	7.4	7.5	10.1	13.4	12.1
March	9.2	8.1	14.4	9.0	10.8	4.9	14.6	14.2	19.1	15.3	25.6
April	23.0	20.2	17.0	26.1	18.8	21.0	15.8	29.1	23.0	25.0	25.8
May	28.2	21.9	25.9	27.3	22.6	28.9	11.5	22.4	24.3	26.6	25.6
June	17.6	22.2	16.6	26.7	14.7	17.9	8.9	18.3	18.6	25.4	25.3
July	19.2	29.1	19.6	18.2	20.6	18.0	13.1	20.1	22.1	25.5	27.7
Aug.	16.7	24.2	24.9	27.2	21.8	20.9	20.4	20.0	20.3	24.6	25.5
Sept.	28.2	18.9	21.7	23.4	16.1	18.6	21.2	19.8	23.9	23.2	37.3
Oct.	23.7	29.3	19.2	18.8	16.4	29.8	12.5	18.5	17.8	24.1	40.6
Nov.	29.6	18.2	14.8	35.7	27.7	14.0	15.9	15.9	19.2	23.3	22.5
Dec.	8.5	5.5	5.2	13.0	12.6	9.3	6.7	8.1	15.5	8.8	6.0
YEAR	225.9	214.4	198.6	249.5	206.2	210.3	155.9	197.7	218.2	240.4	279.8



We can learn a lot from these figures. We must assume that the interest in the Missouri Botanical Garden is reflected by the number of people visiting it. But there are obviously many other factors involved. For instance, when transportation became a problem during the war years, attendance dropped from an average 350,000 persons to a scant 200,000. Yet, when we draw a straight line through the attendance figures, we see that the declining rate of attendance, which started in 1930, continued after the war years, and indicated that, without drastic changes, by 1960, the number of visitors might have declined to a scant 100,000.

In reality, we see that in 1956, a recovery in the attendance has set in, approximately as steep as in the years 1925 to 1930, and that in 1959, this increase has continued. Actually, the number of visitors was very much higher than the actual count at the turnstiles at the Main Gate indicates, for the restoration of Shaw's Tower Grove House and the Centennial activities at the southern end of the Garden have drawn increasing numbers of visitors through the Cleveland Avenue gate. During the Centennial Celebration at least 25,000 visitors must have entered through the Cleveland Avenue gate, where there are no turnstiles, and practically all 3,000 children so graciously received by the Veiled Prophet Queen arrived through that gate.

The table shows that, while in the 1920's and 1930's attendance was irregular with peak months of up to 80,000 visitors, during the last years the attendance is much more evenly distributed over all months and that, except for January and December when, because of bad weather, usually less than 10,000 people visit the Garden, all other months had very regular attendance of twenty to thirty thousand people.

This is of importance in planning for the future. If we can keep attendance so evenly distributed, parking and entrance facilities will only have to be based on top crowds on Saturdays and Sundays, and these top crowds are now more or less evenly distributed throughout the year, in contrast with the '20's and '30's, when the much larger Chrysanthemum Shows attracted crowds many times greater than during the rest of the year.

This indicates that with a proper distribution of shows and displays of outdoor materials, a steady attendance throughout the year can be achieved. It is hoped that our new facilities will contribute to that end.

The Executive Director spent part of the summer in the Southwest and in California in connection with ethnobotanical studies supported by a grant from the National Science Foundation. Dr. Thomas Whitaker from California worked with him at the Garden for several months. Dr. Cutler also represented the Garden at meetings of the Directors of Museums and Taxonomic Collections in Florida.

In the beginning of February the Director returned from a trip through South America, where he studied the vegetation of several regions, especially of the desert regions near Lima, Peru; the shrub vegetations of the Campos Cerrados in the State of São Paulo; the Caatinga in Ceará, and the jungle near Belém. In early June he was present at the garden party celebrating the 200th anniversary of Kew Gardens; in August he attended the International Botanical Congress in Montreal, where he received an honorary Sc.D. from McGill University, and in early November, he traveled to Czechoslovakia and Sweden for consultation about phytotrons. He also participated in phytotron discussions at the University of Wisconsin as well as at Purdue University. He had many speaking engagements:—Science Teachers Institutes in Austin, Texas; Las Cruces, New Mexico; Ann Arbor, Michigan; Vermillion, South Dakota; Fargo, North Dakota; and at our own In-Training Teachers Institute at the Garden. Furthermore, he lectured in São Paulo; Memphis; Rolla, Washington, D. C.; Montreal; Penn. State College; Lubbock, Texas; Prague; Stockholm; Columbus and Chicago, and on many occasions for service and garden clubs in St. Louis.

RESEARCH IN USEFUL PLANTS

EDGAR ANDERSON, Curator

The studies of statistical methods and graphic representation have been continued. In the Spring he taught his Washington University classes including "Field Botany". He participated in the Williamsburg Symposium in March. The Men's Garden Clubs of America presented him with an award of merit at their Cleveland meeting. During the Summer months he traveled to California, Alaska, Costa Rica, Colombia and to the Rocky Mountain Biological Station in Colorado in connection with his researches with useful plants. He spent the Fall semester as a fellow of the Center for Advanced Studies in Behavioral Sciences. He is now back in St. Louis to resume his teaching and research.

THE HERBARIUM

ROBERT E. WOODSON, JR., CURATOR

ACTIVITIES in the herbarium during 1959 were encouraging. Redecoration of the herbarium and work quarters was made possible by a grant from the National Science Foundation. Details of the renovation were planned in consultation with Mrs. Fothergill Graves, a well-known interior decorator of St. Louis and a devoted Friend of the Garden. With relatively limited funds, Mrs. Graves was able to achieve a startling effect with pleasing pastel shades upon the walls, some new furniture and the refinishing of some old. The purchase of absolutely the last additional herbarium cases capable of being crammed within our present quarters has been made.

The staff consists of Dr. Robert E. Woodson, Jr., Curator, Mrs. Barbara Mueller, Secretary, and Dr. George S. Bunting, assisted by Mr. James A Duke, Mr. Jack Wasinger and Mrs. Irene Buersmeyer. The grass herbarium is under the direction of Dr. George Van Schaack, who had the volunteer assistance of Dr. and Mrs. Frederick Comte. It should be pointed out that the entire staff, including the Curator, is on a *part-time basis* quite insufficient to cope with the growing work of our herbarium and barely able, despite their devotion, to keep abreast of incoming correspondence and exchanges. Many important families in the herbarium should be completely reorganized, but the necessary manpower is lacking. The herbarium of the Missouri Botanical Garden is one of the richest in the world, and upon the basis of available statistics is the fourth largest in the Americas. The housing for a herbarium of its size and standing is most inadequate and the care must be limited.

Many accessions of unusual interest were received by our herbarium during the year just ended. It is particularly gratifying to report continued exchanges upon a substantial scale with the vast and extremely active herbarium of the Academy of Sciences of the USSR in Leningrad. During the past summer the Missouri Botanical Garden cooperated with the Yale School of Forestry in a collecting expedition to Darién Province, Panama. The numerous specimens of this expedition will doubly enrich our herbarium through exchange with other similar institutions.

A significant development of the past year was the larger number of requests for loans which our herbarium received. This increase, which was approximately 40% over the previous year, may be construed not only as evidence of a greater general interest in taxonomic research at home and abroad, but is particularly testimony of greater esteem for the collections of the Missouri Botanical Garden.

Research in the herbarium has maintained its usual diversity. Dr. Woodson and Mr. Duke have continued their studies on the Flora of Panama under a grant which they hold from the National Science Foundation. Dr. Woodson also has continued his studies of population structures in butterflyweeds and of drug plants. Dr. Bunting received a National Science Foundation award toward a monograph of the genus Philodendron under the auspices of which he spent the months of November and December collecting in the Yucatan Peninsula. Dr. Dwyer has concentrated his research toward the preparation of manuscript on Papilionatae for the Flora of Panama. Dr. Dressler has pursued various topics in Euphorbiaceae and Orchidaceae. Dr. Dodge spent the year as a guest consultant for the Brazilian Government at the University of Recife.

Five graduate students of the Henry Shaw School of Botany of Washington University have conducted their research in the herbarium during 1959, Dr. Lorin I. Nevling, Jr., having received the degree of Ph.D. at the June commencement. Dr. Nevling recently has joined the staff of the herbarium of Harvard University, Cambridge, Mass.; his dissertation monograph of the genus *Daphnopsis* will be published in the November 1959 number of the 'Annals ofthe Missouri Botanical Garden'. Other graduate students and the topics of their research were: Henry J. Kaltenthaler (B.S., Pennsylvania University, A.M., Washington University)—Rubiaceae; William C. Burger (A.B., Columbia University, A.M., Cornell University)—Moraceae; Howard Pfeifer (A.B., University of Iowa)—Aristolochiaceae; Fuad Safwat (License in Biological Sciences and Education, Higher Teachers College, Baghdad)—various topics in the flora of the Near East.

HERBARIUM RECORDS—1959

Specimens mounted: ca. 23,696 sheets

Exchanges sent: 1,300 sheets

Exchanges received: 3,529 sheets

Loans sent: 10,041 sheets

Loans received: 1,183 sheets

Approximate total specimens in the herbarium: 1,741,000 sheets.

LIBRARY

GEORGE B. VAN SCHAACK, LIBRARIAN
AND CURATOR OF GRASSES

MUCH of the library effort in 1959 was devoted to continuing the rehabilitation program made possible by the National Science Foundation grant, reported a year ago. This grant, received in 1958, provided $60,000 for the herbarium and the library. Significant parts of the library program were binding of back-files, completion of back-files by special purchase, addition of book-repair equipment, shelf-checking and other 'housekeeping', photographic copying of the card catalogue and shelf list, and purchase of cases for these copies.

The card catalogue copy, still unfinished, will replace the old catalogue of 2″ × 5″ cards with photographic copies on standard size library cards. This will permit the future integration of standard cards such as those supplied by the Library of Congress, and will provide, as well, a card large enough for recording necessary bibliographic data. The shelf-list copy, also on standard size cards, will replace the old style paper sheets of odd size, many of which, dating back to 1900, are not in usable condition. The shelf-list copy will be filed adjacent to the card catalogue where it may serve to some extent as subject reference, subject entries being lacking in the main catalogue. The old card cabinets will very conveniently accommodate the Torrey Index, purchased in 1959, which is printed on the smaller size card.

General housekeeping included the shelf-checking of several sections not checked for many years, the replacement of many hundreds of pamphlet covers, and the provision of slip cases for many score of rarer books either already with broken bindings or in fine bindings which should be protected.

Additions to repair shop equipment included a substantial guillotine, a lettering stamper and a large stapler. Acquisition of a contact copier will permit the rapid copying of material for interlibrary loan requests of only a few pages; the books will thereby receive less wear, and the fees obtained will cover the expense involved.

Among many special purchases of books were included the fine 1935 reproduction of the *Herbal of Pseudo-Apuleius,* Dunthorne's *Flower and Fruit Prints*, and the third edition of Evelyn's *Sylvia,* 1689. The last-named filled the gap in our otherwise complete series of the first five editions. Journal files completed included Planta (17 volumes) and the Proceedings of the Linnean Society (18 years). Our copy of the Map of Hispanic America was completed as far as possible by the purchase of 47 sheets.

In addition to the normal accession of some 600 journal volumes, 202 books were catalogued. Some 958 books were returned from the bindery, and over 200 prepared for binding.

Of several gifts to the library one of nearly $500.00 deserves special mention because of its character. The gift was made up of donations in honor of the birthday of one of the Friends of the Garden. The money will be used to repair and replace fine bindings on some of our old and rare books.

The library participated in the celebration of the Centennial of the Garden by preparing an exhibit of over 50 of our illustrated volumes. The City Art Museum graciously provided a gallery where, during November, these volumes were on display, arranged to show the history of various techniques in making flower prints during the last 500 years. An illustrated catalogue of the exhibit prepared by the librarian and Erna Eisendrath constituted the final number of the BULLETIN for 1959.

EDUCATION

CLARENCE BARBRE, INSTRUCTOR
JOSEPHINE DAVIES, ASSISTANT IN EDUCATION
KENNETH O. PECK, IN CHARGE OF VISITORS' ACTIVITIES

A PROGRAM of activities for children from 7 to 18 is given every Saturday morning from 10 to 11:30 A. M., no admission charge or registration required. These programs were very successful in 1959 and 460 children took part. The more active programs, like making Christmas decorations, planting miniature gardens and potting bulbs to take home, attracted large numbers. The attendance throughout the year was remarkably steady except during the summer vacation period and the colder days of fall and winter. Some high school biology instructors give extra credit to students who participate in the Saturday program.

The Pitzman Nature Program for the second year offered four courses in the natural sciences, at both junior and senior levels, covering birds, animal and insect enemies, trees, and other plants. There were 365 registrations for the two 5-week sessions and 245 children completed work for certificates. As a part of the Pitzman Nature Program, one group of children from each session was chosen to form a Junior Research Team. Under the guidance of Mr. Peck, Miss Davies, and Miss Beth Andrews, summer assistant in Education, they completed research projects on lawn weeds and the kinds of oak trees in the Garden. A report of their work was published in the September BULLETIN. Displays the groups prepared were exhibited at the Main Gate. Mr. and Mrs. Earl Hath, Miss Jeane Stern, Mr. and Mrs. Stuart O'Byrne, Miss Helen Bowman and Mr. Harry Licht, members of the St. Louis Audubon Society, conducted the groups in bird study.

In October nearly 800 children from local schools visited the Garden to plant paperwhite Narcissus bulbs. Each student was given a short period of instruction on what bulbs are and how to grow them. Each potted two bulbs which could be taken home.

About 90 tours were given to groups of children and adults. The tours varied in scope according to the interests of the particular group. An encouraging number of teachers are bringing their classes to the Garden where they can study the excellent materials we have to offer.

For many years Mrs. Paul Britt has directed the Volunteer Guide Service for the Garden. Groups of people

Children enjoy trip through North American tract to collect study material.

from all over the country, local organizations of adults and children, and many school groups have been guided through the Garden by Mrs. Britt and the ladies who have been specially trained in her organization. Their help makes it possible to conduct many more groups than our limited staff could handle. They do it so well that we receive frequent letters of praise for their work.

The Tree Trail continues to be very popular and last year about twelve thousand people followed it with the free guide-pamphlet which is given to visitors at the Main Gate. A new Nature Trail which will show the relations of plants and animals to their environment is being developed. It is designed to stimulate thinking of the relationships of man and with all other organisms.

Adult courses in Spring and Fall Wild Flowers, Botany for Home Gardeners, Grounds Care, Horticulture, Orchid Growing, Bulb Forcing and Plant Propagation were offered in 1959 and enthusiasm of the students was high. Clarence Barbre's Plant Propagation and Spring Horticulture courses had 160 students and Gillespie's Modern Horticulture for Home Gardeners, offered for the first time last year, was filled nearly to capacity in both Spring and Fall sessions.

ORCHID COLLECTION

R. J. GILLESPIE, in charge of Orchids

Routine work as usual occupied most of the time of the Orchid Department during the year of 1959. The entire collection is now adequately potted and the cultural condition of the plants is greatly improved. Almost all of the cultural set-back due to the transfer from Gray Summit has been overcome.

An evaporative-pad cooling system was installed in the "New Introduction" house and was used during the warm months. The temperature of the house was held 10 to 15 degrees below the outside temperature, thus helping the newly introduced plants to become established. This was the first cooling system to be installed in any of the greenhouses in the city Garden.

A system of automatic watering with rain-jets was installed in 4 of the Orchid houses and gives an excellent drop-type precipitation. It is hoped that the entire collection will be watered automatically by the end of 1960.

For the annual Orchid Show a simulated room was designed, displaying orchids in 4 picture windows. A basement Orchidarium, using artificial light, was designed and built to demonstrate basement orchid culture. An Orchid Garden and several other displays, including one staged by the Orchid Society of Greater St. Louis were also featured.

During the Centennial Flower Festival the Orchid Department exhibited a tiered circular staging, massed with Cattleya hybrids. An artificial "Orchid Tree" was designed and built for the show. It was planted with numerous "botanical" orchids and plans are underway to build several additional "Orchid Trees" in the coming year.

A continuous display of Orchids was maintained throughout the year in the alcoves and in the "Botanical Orchid" House. During the year the display areas were enlarged and made more elaborate by adding a Cattleya staging at the entrance of the "Bromel House" and also by placing several shadow boxes in the existing display areas.

Cut orchids were supplied weekly for flower arrangements in the Shaw House. As usual, flowers for the traditional "Queen's Bouquet" were supplied during the month of October.

ACCESSIONS

The year 1959 was the most active year in over a decade for new introductions into the orchid collection. A total of 1012 new plants were acquired during the year. By far the majority of these were"botanicals" from Central and South America. However, the hybrids were not neglected and a series of new hybrid introductions added considerably to our collection. Notable among these was a collection of hybrid Cattleya, Miltonia, and Paphiopedilum donated by Mr. George Butterworth of Framingham, Mass. Another valuable accession was a collection of modern hybrid Cattleyas acquired from the B. O. Bracy Co. of Santa Ana, Calif. Among the "botanicals" the most notable accessions were the plants received from Mr. C. H. Horich of Costa Rica. Numerous rare and unusual "botanical" species were received from Mr. Horich and these plants, along with other newly acquired "botanical" orchids, establish the collection as having more Genera and Species at the present time than at any other period in its history.

RESEARCH AND INSTRUCTION

Four orchid courses were given by the Garden during the year. Two of these were all-day courses and the others were three hours each. These courses were well attended and are being offered again in the coming year. An experiment to test orchid potting media was set up under the direction of Dr. Went. It consists of 4 blocks of Cattleya × Mrs. John Lehmann potted in various potting media. This experiment is still in progress and will be concluded in 1960.

Several articles were published by the Orchid Department during the

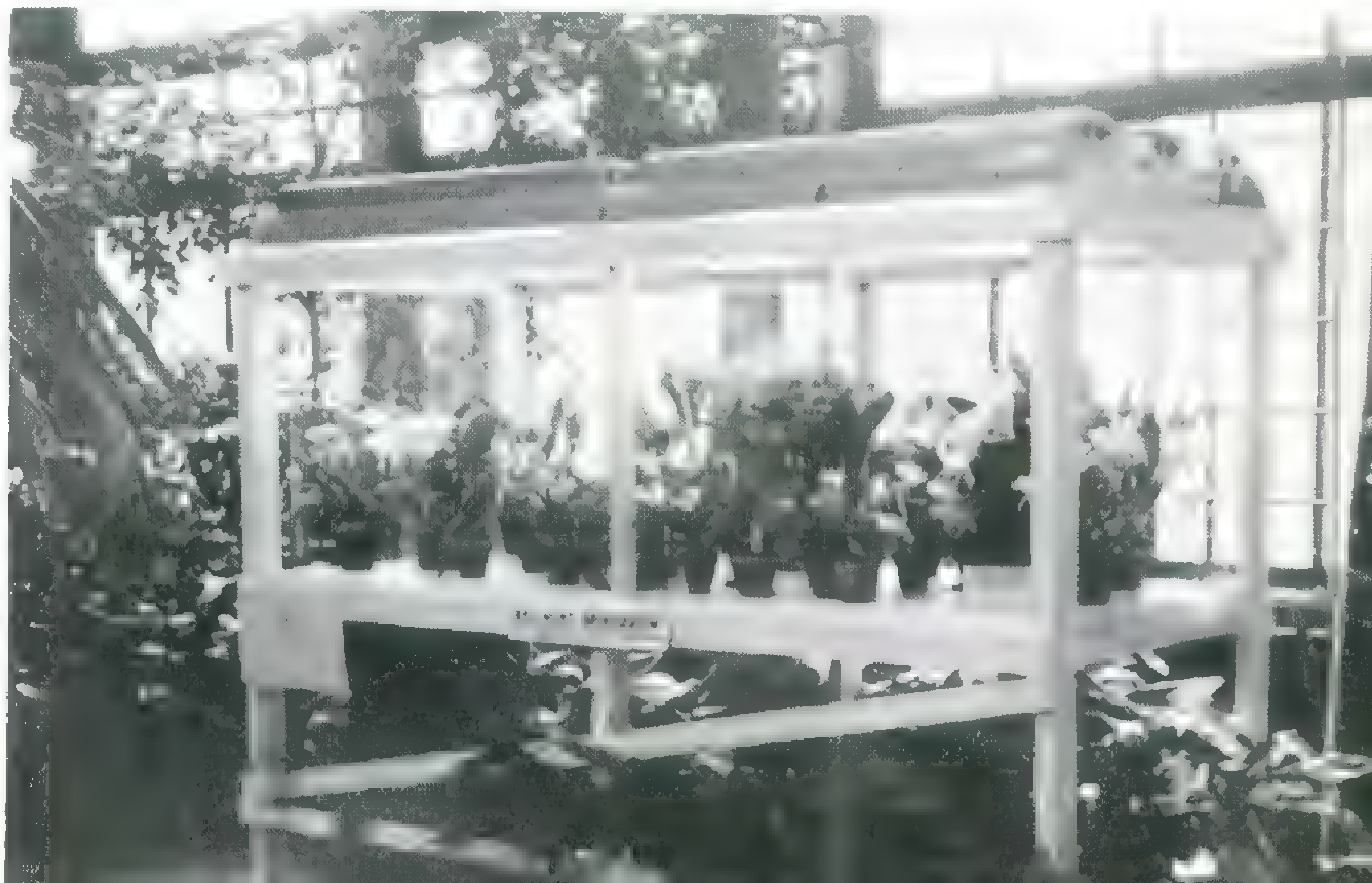


Illustration of an Orchidarium such as an individual might construct for his basement.

year in national orchid publications. These articles dealt with such topics as orchid culture and orchid hybridizing. The February issue of the Missouri Botanical Garden BULLETIN was also devoted exclusively to orchid culture.

MID-AMERICA ORCHID CONGRESS

In October the First Mid-America Orchid Congress was held in St. Louis at the Community Federal Savings and Loan Assn., St. Ann, Mo. The Orchid Department participated in the congress in a number of ways. A display depicting 50 years of orchid research at the Garden was built and staged. Orchid staff personnel were active as judges, panel moderators, and speakers. After the congress and show were over, Community Federal Saving and Loan Assn. presented to the Garden a display arch, which they had constructed as a show prop, to be used in future Garden displays.

PLANT INTRODUCTIONS

E. L. EVINGER, HORTICULTURIST

THE active introduction of new materials for the outdoor garden has been temporarily held up pending the implementation of the new master plan. Nevertheless some fifty to seventy-five new species were incorporated into the garden in places unlikely to be affected by any physical changes in garden design. Many of the plants of an easily replaceable nature that were being grown for the outdoor garden were released through the plant sales booth at the Centennial Celebration.

Some twenty new lots of seed and cuttings were received and about seventy-five entries of small plants were made during the season. These will be grown and held in the greenhouse or nursery pending the time the garden will be ready to receive them.

The Experimental Greenhouses have been utilized this past season to grow nearly eighty kinds of tropical plants, mostly trees, for use in the Climatron. These are primarily from seed brought back by Dr. Went from his South American travels, and include many spectacular tropical flowering trees.

GREENHOUSES AND CONSERVATORIES

LADISLAUS CUTAK, HORTICULTURIST
AND GREENHOUSE SUPERINTENDENT

IN anticipation of tearing down the Palm House and its wings, our workmen began digging up the plantings as early as April and transferring them into tubs. It was hoped that most of the larger trees and shrubs in the houses scheduled for demolition could be left intact, but when the wrecking crew arrived to begin tearing down the buildings, we decided to employ all available Garden help to save as many of the plants as possible and move them to the Old Citrus House where trenches were dug and the plants heeled-in. Most of the material is doing rather well and will no doubt stand another transplanting when the Climatron is ready to receive them. Pring Landscapers helped with their heavy equipment to move the tallest palms and the transplants would likely have taken hold had not sudden early freezes caused their demise. Protection covers were hastily assembled over others but these, too, are feared lost. The trunks which remain will be used later on to display epiphytes.

The waterlilies, which have won world-wide acclaim, were enjoying one of their best years, producing lovely riotous displays of color throughout the summer and autumn months. The front pools were fertilized and plowed on April 7th and actual planting of waterlilies began on May 6th. The plants took hold almost immediately and soon were producing flowers in abundance. Waterlilies are started from tubers in greenhouse tanks in January, pricked off and transplanted as needed, and before they are set outdoors make a lovely display in the green houses where visitors can watch their development from seed or tuber to flowering plant. The waterlilies are propagated by Mr. Frank Korte, who has performed this task for many years. The waterlilies in the outdoor pools kept on blooming through the month of October but on November 3rd were finally removed.

The cacti and succulents came into their own on several occasions during the year. During the whole month of July an excellent display of these plants was staged in the Flower House by the Henry Shaw Cactus Society in cooperation with the Garden. The Cactus and Succulent Society of America held its eighth biennial convention in St. Louis, July 7 to 11, and many commercial growers sent exhibits. After the show the plants were donated to the Garden's collection. Noted exhibitors were Johnson Cactus Gardens, Beahm Gardens, Gates Cactus and Tegelberg Cactus from California; Karr Cactus from Colorado, Desert Botanical from Arizona, and Siesta Cactus Gardens from Florida. Local members also had meritorious displays such as those of Carl Snyder, Harry Hoettger, the Stampehls, Al LePage, Zee Young and Bill Fischer. The July Show marks the first time that any individual society attempted a month-long exhibit and it proved a success. During the Centennial festival in late September another cactus display was shown in the Flower House. This was also the first time that the three greenhouse departments combined their talents and resources to put on a rather pleasing show with the flavor of a three-ring circus. Thus cacti, orchids, bromels and bedding plants were utilized to produce a harmonious show.

Potted cacti, which since 1933, were kept in back of the Cactus House for convenience were removed to the Seedling and Introduction House in the Exotic Range where they can be more easily and readily managed under present conditions. A number of natural trees and stumps were planted with bromels and exhibited in the Orchid Show in February and also in the Centennial Show in September. The bromels in the flower, especially *Tillandsia cyanea* and

Vriesia "Mariae," evoked much comment and, strange to say, drew some attention away from the flamboyant orchids. Some of these prepared bromel-studded trees will be used in the Climatron when completed.

As usual, novel requests coming to the Garden were fulfilled; among these the supplying of palm leaves for Muny Opera's production of "The King and I" in Forest Park, decorating the Khorassan Room of Hotel Chase for the Veiled Prophet Ball, furnishing plants and facilities to photographers and artists, as well as to radio and television stations.

FLORAL DISPLAYS DURING 1959

PAUL A. KOHL, Floriculturist

In early January tulip bulbs were potted and placed in coldframes. These were brought to the greenhouse in February for later use in the Easter display. In mid-January the poinsettia show was replaced with an arrangement of Primula obconica and Primula malacoides. This display was later included in the orchid show which opened with a preview on February 5. The orchid show was planned to simulate an orchid fancier's living room with doors opening into the garden. Orchids were displayed in windows and in the adjoining garden plants were arranged in the manner a grower would place them outdoors during the summer months.

KMOX-TV's mobile unit "On Location" produced a thirty-minute broadcast on the orchid show on February 7 and on April 4 covered the spring flower show.

From March 7 through the 15th the Greater St. Louis Outdoor Living, Flower, Home and Boat Show was held in the Kiel Auditorium. In this show the Garden staged a picture display of garden activities surrounded with groups of azaleas, genistas, cinerarias, narcissi and orchids.

The Easter display which contained fifteen kinds of flowering plants was completed on March 20. To mention a few, there were azaleas, cinerarias, genistas, marguerites, nasturtiums, lilies and at the north end of the display, a Dutch garden of daffodils and tulips. This was the largest display of tulips on exhibition in recent years. On April 11 and 12 the third annual daffodil show occupied the north end of the flower house. One hundred and seventy foliage and flowering plants were taken to Christ Church Cathedral and arranged for the annual Henry Shaw flower sermon April 26. The seventh annual African Violet Show used the flower house May 2 and 3. Dr. John C. Wister lectured on daffodils, iris and peonies to 200 members and friends of the St. Louis Horticultural Society in the Floral Display House May 4th. Pelargoniums were displayed for the week of May 5th, and on May 16 and 17 the St. Louis Horticultural Society held its spring flower show. This was followed by a display of hydrangeas and on May 23 and 24 the Rose Society of Greater St. Louis held its annual show.

During July a cactus display occupied the flower house. On August 8 and 9 the Illinois Gladiolus Society held its annual show. Caladiums were then displayed and in late September were replaced with a special exhibit for the Centennial Celebration. This display was divided into three sections: one for colorful foliage plants; a grouping of cacti and succulents; and the third was devoted entirely to orchids. For the first week-end of the Centennial, September 26 and 27, the Dahlia Society of Greater St. Louis held its show on the balcony of the flower house and in the corridor along the orchid alcoves in the aroid house.

At the time of the Centennial a model of the geodesic dome and plants from the Garden were set up at St. Louis Lambert Airport and attracted much favorable comment. It was returned to the Garden December 9 and placed on the balcony of the flower house.

In late September the Garden donated foliage plants to the Academy of Science of Greater St. Louis for its opening celebration September 29. The Garden loaned palms to the Chase Hotel for the Veiled Prophet supper on October 5. The Queen's bouquet was exhibited on October 7 and a duplicate bouquet on October 11. The sixth Systematics Symposium and Luncheon was held in the flower house on October 16. Our palms were used in the City Art Museum to enhance the Garden's display of flower prints from October 30 through November 26.

The annual chrysanthemum show opened with a preview on November 5. The display contained a colorful collection of cascade chrysanthemums and particularly noteworthy was a large group of Japanese spider chrysanthemums representing fifteen varieties which were sent to us by the Longwood Gardens of Kennett Square, Pennsylvania. The Christmas show of poinsettias, chrysanthemums and peppers opened December 11.

Small-flowered cascade and new Japanese spider chrysanthemums from the Longwood Gardens recently introduced by the United States Department of Agriculture.

MAINTENANCE

MAINTENANCE of the physical operations of the Garden were divided between the Engineering and the Grounds departments early this year, The mechanical work having to do with heating systems, water, sewer, general plumbing, electrical and motorized equipment in the one department; while all other operational activities are under the Grounds Superintendent.

ENGINEERING

KENNETH SMITH, ENGINEER

THIS Department under the supervision of the Engineer and the Assistant Engineer James Hampton performed the usual efficient maintenance and repair work. Sometimes this required much time, patience and ingenuity incident to old, out-moded and worn facilities.

The removal of the old Palm, Economic and Fern greenhouses preparatory for the new Climatron created a number of problems of salvage, moving of steam, electrical, water and sewer connections.

Special or new work included wiring of the Orchid ranges for fans and water connections to provide for both cooling and automatic watering systems. A Catalytic burner installed on a trial basis in the Experimental Green house required considerable detail study and work of installation.

The Centennial Celebration brought numerous vexing problems of temporary wiring for lights, heaters, sound, and their maintenance during the period.

GROUNDS

LOUIS G. BRENNER, ARBORIST AND GROUNDS SUPERINTENDENT

THE effectiveness of the rehabilitation program for the grounds, inaugurated some 5 years ago, became decidedly apparent during 1959, a year of bustling activity for the grounds crew faced with the task of grooming the 70 odd acres of the Garden in preparation for the Centennial Celebration in October. Removal of the many weedy and duplicate trees of poor quality, large scale use of mulches, redesign of shrub and perennial beds, and use of power tools have been important factors in streamlining care for the outside grounds, making it possible for a small crew of men to perform reasonable maintenance with minimum of man-hour effort. This program has been so effective that the grounds crew was able to undertake additional tasks connected with the Centennial Celebration and construction of the Climatron without sacrificing the overall appearance of the grounds.

The 70 acres of the Garden, painting and carpentry work on interior and exteriors of buildings is maintained by a regular crew of 8 men including Joe A. Baker as foreman of the Grounds Maintenance Crew and Jess Mayhan as Painter-Carpenter. During the summer, with the heating plant shut down, two of the firemen are temporarily assigned to the Grounds and Maintenance Crew.

Winter and early spring months found the crew busy removing a few remaining trees of poor quality, a practice which has accentuated the splendor of the many fine old specimens growing on the grounds. Having removed many such weedy species in past seasons it is now possible to direct more effort toward specific maintenance of remaining specimens. Similarly considerably more time was devoted toward maintenance of shrubs. Important care of these woody plants includes proper pruning in season, and widespread use of wood-chip mulch which provides excellent soil protection, maximum benefit of fertilizers as well as reducing the many hours of laborious hand weeding.

Lawn areas show considerable improvement over preceding years. Coupled with a moist cool spring and early summer, a wet fall and rather mild forewinter, they reflect the attention toward reseeding given during February and early March. Widespread use of power equipment for application of herbicides has given good control of most noxious lawn weeds at low man-hour cost.

Early spring found the men busy cleaning out the marsh meandering through the west side of the Knolls. Here the drainage became poorly defined causing an expansion of the marsh area, a problem to maintenance of lawns in the surrounding area. The drainage was deepened thus lowering the surrounding water table and at the same time much of the weedy marsh growth was reduced making room to add other attractive marsh plants such as cardinal flower *(Lobelia cardinalis)*, marsh mallow *(Hibiscus moscheutos)*, lizard-tail *(Saururus cernus)*, and water willow *(Dianthera americana)*. Clearing of the marsh has had further benefit in making an excellent watering and bathing site for song birds, providing a popular locale for summer nature class instructors to bring classes for instruction in bird habits and identification.

While a portion of the crew were engaged in altering the marsh in the Knolls others were busy resodding the walk edges in the Linnean and Rose Gardens with sod cut from a remote corner of the garden. Though this operation consumed many long man hours it has made it possible to mow these turf borders in less than 1/4 the time required in preceding years. Such turf borders had built up over the years with soil dropped from the roots of weeds until they stood above the level of the walks. The high crown of these sod borders made mowing difficult and time consuming.

The Centennial Celebration planned for October required Spring and Summer preparation. Special beds in the Knoll area were prepared for mass plantings of chrysanthemums and dahlias by volunteer efforts of the members of the St. Louis Chrysanthemum Society. Abandoning the Italian Garden, because of construction of the Climatron, made it possible to put more labor effort into caring for the Linnean Garden, plantings along the tropical lily pools and the mum and dahlia plantations in the Knolls.

The Rose Garden has continued to be an outstanding attraction of the grounds and presented a multitude of brilliant blooms during the 1959 season. New rose introductions, supplied by commercial growers prior to sales release, have aroused increasing interest among visitors, many of whom now make regular visits to observe and evaluate these handsome introductions. The low maintenance schedule for the Rose Garden has proven sound and practical. Having a heavy mulch on the ground year round, the plants are not hilled in winter. In mid-November the canes are screened from winter sun with light covering of coarse hay, or evergreen branches if available. Use of high pressure spray equipment designed for shade and orchard tree protection has given superior protection from mildew and black-spot in the Rose Garden when a fog spray is used. No damage to the plants has been experienced in using this equipment and complete protection is obtained if a regular spray schedule is adhered to.

The crew has taken an active interest in the construction of the Climatron and has contributed considerable effort toward the success of this outstanding achievement. Grounds men supplied a large portion of the labor required to remove and store plants from the Palm, Fern, and Economic Houses prior to wreckage. They were also active in salvaging many usable materials during wreckage of these buildings.

Concerted efforts of the newly formed Historical Committee to complete restoration of the Henry Shaw Country Home in time for display during the Centennial Celebration required numerous hours of labor in moving furniture when rooms were papered and painted. Grounds crewmen cheerfully applied themselves to this task requiring patience and extreme care in handling the many fine pieces of old furniture on days of sweltering August heat.

It was natural that the grounds crew play an important role in the celebration of the Garden Centennial for which it was necessary to move many tables, chairs, benches and other properties to arrange the various attractions. The sales booth area on the lawns of the Shaw residence required daily service to remove rapid accumulations of trash and refuse. Principal areas of the Garden grounds required similar additional maintenance during this period.

Early in the year carpentry and painting maintenance of the Garden buildings was separated from the Engineering Department and assigned to the Grounds Department for supervision. In addition to routine maintenance of buildings and greenhouses during 1959 the exterior of the Linnean House was enhanced with a fresh coat of paint. Before painting, however, it was advisable to replace many window sills that the building be kept weathertight and to minimize heating costs. Working in the same vicinity trellis work in the Linnean Garden was repaired and painted. During the summer the entry to the Floral Display House was also repaired and painted thus improving the aspect of the many fine floral displays offered to the visitors.

INFORMATION CENTER

Mr. George Pring, Superintendent, and Miss Isabella Powell, Friends of the Garden secretary, maintained our Information Center at the Main Gate, Miss Powell answering questions, selling books and pamphlets which tell about plants, and doing all the secretarial work connected with the Friends of the Garden.

Mr. Pring answered numerous requests for expert information, appeared on television and radio programs and gave a number of lectures. He visited Longwood Gardens as a Consultant for their new waterlily pools. Many new books and pamphlets are now available and the number of people who come to the Information Center for special publications on plants is increasing.

ARBORETUM

FRANK L. STEINBERG, Superintendent

The Arboretum continues to be managed with a skeleton crew, yet the roads have been kept open, the grasslands managed and pruning and clearing continued. The area about the Pinetum Lake is open to cars daily and for six weeks in April and early May, the longer drive past the dogwoods, redbuds and many drifts of naturalized daffodils to the trailhouse and the wildflower trails was kept open.

Mowing required 631 tractor and man hours. The Pinetum was mowed in the late spring and again in the fall. All planted groups in the Pinetum were cleared of brush and sprouts, and dead trees were removed. All of the groups are clean and this should help to show off the narcissus display in the spring. Mowing 120 acres on the farm requires 108 tractor and man hours.

New furnaces were installed at the Gate House and the Diener residence. Minor repairs were made and some painting done at the Steinberg and Brenner residences.

PUBLICATIONS

ROBERT L. DRESSLER, Editor of the Annals
E. L. EVINGER, Editor of the Bulletin

Volume 46 of the Annals included one fascicle of the Flora of Panama, by R. E. Woodson, Jr., and Collaborators; papers by C. K. Dodge, Lichens of Africa; The Genus Daphnopsis by L. I. Nevling; and several shorter papers.

The first four numbers of Volume 47 of the Bulletin were edited by Evelyn Barbour and the last two by Virginia McMahon. Beginning with Volume 48 number 1, 1960, the Bulletin will be published ten times a year with E. L. Evinger as Horticulturist and Editor.

MISSOURI BOTANICAL GARDEN PROGRAMS

SPECIAL Shows and Displays:

African Violet Show, March 5 and 6

Daffodil Show, April 8 and 10.

Easter Display, April 17.

Free Nature Programs for children, aged seven and over, are held every Saturday morning from 10:00 to 11:30 A. M. Museum Building.

The Life Secret of a Plant, March 5.

The Story of the Pin Cushion Forests, March 12.

Make Your Own Dwarf Gardens, March 19.

Color Sound Movies, March 26.

Sowing Seed for Your Garden, April 2.

Flower Shapes and Names, April 9.

Hunting for Hidden Flowers, April 16.

Spring Safari, April 23.

More About Your Garden Seeds, April 30.

Free summer programs of nature study for children are supported by a gift from the Pitzman Foundation. Trails, craft-work, and group activities are offered. Schedules of these programs may be obtained in June at the Main Gate.

COURSES

The following courses are open to any interested person. Certificates are awarded upon the successful completion of any course.

Information on registration may be obtained by calling PRospect 6-5567

Please send all registration fees to

Missouri Botanical Garden
2315 Tower Grove Avenue
St. Louis 10, Missouri

Registration fees cannot be refunded after the last day of registration for any particular course.

The courses will meet in the classroom of the Garden's Museum Bldg.

To reach the Museum, enter the Garden through the walk-in gate opposite Cleveland Avenue at 2221 Tower Grove Avenue. The building is on the left.

BOTANY

Course 101. Spring Wild Flowers of Missouri.

Place: Museum Bldg. *Time:* Five Monday nights, 7:30 to 9:30 P. M., starting April 11. *Fee:* $15 for the five sessions. *Enrollment:* Limited to 18 students. (Additional sections will be opened if necessary.)

The aim of this course will be to teach basic flower terminology and use of Steyermark's "Spring Flora of Missouri" by examination of as many different species of native plants as possible. At least one class meeting will be a field trip to the Garden's Arboretum at Gray Summit on a Saturday afternoon. The flowers studied will include representatives of shade trees and shrubs.

Two small texts will be provided; more comprehensive treatises will be available. *Instructors:* Dr. N. H. Nickerson, Dr. Robert Dressler.

Course 103. Ferns of the St. Louis Area.

Place: Museum Bldg. *Time:* Five Thursday nights, 7:30 to 9:30 P. M., beginning April 28. *Fee:* $15 for the five sessions.

To the person interested in unusual

plants, ferns offer a unique opportunity; with relatively little effort, one may become acquainted with all species native to a particular region. This course includes some details of fern structure and life history, methods of recognition of species native to the area, and observations on environmental situations in which individuals of the various species may be found and grown in living collections. One class meeting will be a field trip to the Garden's Arboretum at Gray Summit on an afternoon to be mutually arranged. No previous knowledge of ferns is required. *Instructor:* Dr. George Bunting.

HORTICULTURE

Course 122. Spring Horticulture.

Place: Museum Bldg. *Time:* (Register for only ONE of the sections offered.)

Section I. Wednesday afternoons, 1:00 to 4:00 P. M., March 16, 23, April 6, 13, 20.

Section II. Friday mornings, 9:00 A. M. to 12:00 Noon, March 18, 25, April 8, 15, 22.

Section III. Monday afternoons, 1:00 to 4:00 P. M., March 21, 28, April 11, 18, 25.

Section IV. Tuesday nights, 7:00 to 10:00 P. M., March 22, 29, April 12, 19, 26.

Fee: $18 for five meetings. *Enrollment:* Each section is limited to 20 students.

This course will teach beginning gardeners how to propagate plants from seed. Special emphasis is placed on annuals and perennials. Each session will include a lecture period and a practice period. The lectures will discuss factors affecting plant growth and practical means for their control, such as optimum supply of heat, light, moisture, air, fertilizer, lime, mulch, pest and disease control. Each student will receive seeds and four metal flats with sterilized soil. There will be enough space to grow 300–350 seedlings which, with the flats, may be taken home. Seeds of those plants particularly desired by a student should be brought to the first session. *Instructors:* Mr. Clarence Barbre, Mr. Kenneth Peck.

ORCHID CULTURE

Course 141. Orchid Culture in Home and Greenhouse.

Place: Museum Bldg. *Time:* (Register for only ONE of the sections offered.)

Section I. April 16, 10:00 A. M.

Section II. April 23, 10:00 A. M.

Fee: $10 for one meeting. *Schedule:*

10:00 A. M.: Orchids suitable for home culture and the best ways of growing them. Potting demonstrations.

12:00 Noon: Lunch. Garden supplies coffee and soda.

1:00 P. M.: Growing orchids in unusual containers in the home. Basket slabs, poles, and the like, with examples and demonstrations of potting and care.

2:00 P. M.: Inspection of greenhouses.

3:00 P. M.: Individual potting instruction by members of Orchid Department staff. Students may take potted plants home.

Instructor: Mr. Robert J. Gillespie.

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Julian A. Steyermark	Research Associate
Frank Steinberg	Superintendent of the Arboretum, Gray Summit
George B. Van Schaack	Librarian and Curator of Grasses
Trifon von Schrenk	Associate Curator of the Museum
Robert E. Woodson, Jr.	Curator of Herbarium

SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at TOWER GROVE, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the TOWER GROVE mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. spring to fall and until six in the winter time though the greenhouses close at five. TOWER GROVE, itself, Mr. Shaw's old country home, is open from one until four, admission fifty cents, with special guides. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one most used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southhampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 A. M., but is closed on Saturdays, Sundays, and holidays. The Cleveland Ave. gate, 2221 Tower Grove, is nearly always open, and there is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., State Highway 100 adjacent to Interstate Highway 44. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.

MISSOURI BOTANICAL GARDEN

Bulletin

April 1960
Volume XLVIII
Number 4

NEW FRIENDS IN A FAMILIAR SETTING

Dr. Frits W. Went with Friends of the Garden officers, Mrs. William R. Bascom and John R. Averill, enjoying a March snow at the Garden.

Cover photo shows Dr. F. W. Went with new officers of Friends of the Garden, John R. Averill, president, and Mrs. William R. Bascom, vice-president.

The new officers and increased benefits and activities for the Friends were announced in March at a preview of the Spring Flower Show. An office and reception room for Friends are now located at the main gate, and plans are being made for volunteer programs and enlarged membership. Because of increased costs, the mimimum annual fee for membership in the Friends was advanced from $5 to $10.

Dudley French, Trustee emeritus, was honored at the March announcement party for his devoted service to the Friends organization.

CONTENTS

Peat for Your Garden
The Magic of Herbs
Lianas for House Plants
Board of Trustees
Book Reviews
Garden Programs

* * *

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PEAT FOR YOUR GARDEN

HENRY N. ANDREWS, Jr.

THE Gaspé peninsula of eastern Canada is a region of rapidly growing popularity with American motorists. One may be a bit more inclusive and say that the coast line from southern Maine to Quebec City, for those who love the hills and the sea in close proximity, is one of the longest and loveliest stretches that can be traversed by automobile. Although there is much uniformity in topography and vegetation throughout the entire region, each bend in the road—and the bends are legion—offers something a little different; there are vast stretches of spruce forests producing rivers of pulp logs, innumerable charming fishing villages, and water that is just a little too cool to swim in but so blue you can't resist giving it a try. Most travelers will probably agree that the climax comes at the village of Percé far out at the tip of the peninsula, but there are still a hundred miles or more of unspoiled northern beauty whether one remains with the coastal route or takes the inland one cutting across one corner of the Gaspesian Park.

Then continuing in a southwesterly direction along the south shore of the St. Lawrence gulf, headed in the general direction of Quebec City, the terrain becomes somewhat less rugged. The hills are long and rolling, but to add variety, far to the north across the river lies the southern fringe of the Laurentian highlands—dashed with the first snow of winter if one happens to see them a little late in the season.

The vegetation now offers a faint suggestion that the Arctic is not far away and one of the richest experiences for the gardener or botanist still lies ahead, for from St. Anne-des-Monts for about three hundred miles on to Quebec one passes vast level stretches of bog lands where, for several thousands of years, unique communities of plants have been growing, dying, and building up deposits of peat that are now being exploited to the economic advantage of industrious Canadians and the horticultural benefit of American gardeners.

Bogs vary in character. They range in size from a few acres to ten thousand. In some there is little else other than Sphagnum (peat moss) while in others there is quite a diverse flora. The bog may be a lake in the last stage of being filled in or it may be a very level, wet stretch of land on which plants have been growing for centuries. Since this is not a learned discourse on bogs in general, my discussion will be confined to just one. In the course of an excursion following the recent Botanical Congress in Montreal, the writer had an opportunity, with an international group of botanists, to visit a bog near the town of Rivière de Loup. It is representative of the Gaspé boglands and since much of the peat that is mined there is shipped into St. Louis it may be taken as typical from a horticultural standpoint.

The Rivière de Loup bog covers about 7,000 acres of very nearly level land. Only a portion of it is shown, extending from left to right through the center of the picture (photo 1); the packing plant may be seen at the left and the conspicuous long rows are stacks of drying peat.

A portion of the Rivière de Loup peat bog stands out as a broad band through the photo from left to right. The southern Laurentian highlands appear faintly in the distance.

Descending the hillside to an untouched part of the bog we find it to be a unique living organism composed of a group of plants that are in large part adapted to this particular environment, although there are also a few misfits. The dense knee-high vegetation (photo 2) consists for the most part of heath family plants with the following predominating: sheep laurel *(Kalmia angustifolia)*, Labrador tea *(Ledum groenlandicum)* and bog rosemary *(Andromeda glaucophylla)*. Scrambling through these plants is a fairly dense growth of the small cranberry *(Vaccinium oxycoccus)*. Forming the basal mat that one actually walks on is a thick, moist mattress of mosses, three species being most abundant: the true peat moss *(Sphagnum)*,

The living bog. Sheep laurel, Labrador tea and bog rosemary make up the conspicuous low shrub element; larch and spruce trees appear in the background.

the hair-cap moss *(Polytrichum)* and a species of *Hypnum,* a plume moss or one closely related to it. Also admixed with these is a liberal sprinkling of Cladonia, a delicately branching, gray-green lichen sometimes known as reindeer "moss". A few other plants are found with a little searching—pitcher plants are scattered here and there over the bog, cotton grass and the round-leaved sundew may be encountered, as well as blueberries, birch and alder. The trees that appear in the background are larches and spruce; they may occur scattered individually or occasionally fairly dense stands have taken over on apparently slightly higher parts of the bog. These are among the misfits of the bog vegetation; they rarely attain a height of more than 20 or 30 feet, apparently finding the situation a bit too moist for their liking. The whole life of the bog is in fact largely regulated by the water content. If the water level is a little too high most of the woody plants find it unsuitable, or if the bog is drained, naturally or artificially, the moss growth slows down and the shrubs and trees take over more or less completely.

All of these plants contribute to a greater or less degree to the accumulation of plant debris—leaves, stems, roots and pollen which ultimately become peat. The climatic requirements are, however, quite critical for, in addition to the right amount of moisture, the weather must be warm enough to allow quite vigorous growth for a few months during the year yet cool enough so that the plant debris will only partially decay.

Only a few inches below the moss-lichen-cranberry carpet is the peat itself. There is no soil in the usual sense; very little mineral matter is available to the plants and this in itself would inhibit the plant growth. We may move next, then, to a portion of the bog that is being "harvested". Here (photo 3) we find the living vegetation has been stripped away and the light-chocolate brown peat exposed. This varies in thickness in the Rivière de Loup bog from four to thirty feet and recalling that it extends over 7,000 acres some idea of the quantity of peat is made evident. This is only one of many such bogs found along the south side of the St. Lawrence between Quebec City and the tip of the peninsula.

Due chiefly to the problem of drainage, only the top four feet of peat is removed. It is then cut into blocks that measure about 16 × 7 × 6 inches and stacked up to dry, ridding the raw peat of most of its water content being one of the major problems of

The vegetation has been stripped off and about four feet of peat cut out leaving the broad channel through the right side of the photo. At the left are stacks of drying peat.

production. The texture of the fresh peat seemed to me most aptly compared with partially rotted rope that has been firmly matted together. We were informed that it is allowed to remain stacked for about a year, when it is ground up and packed into bales, being then ready for garden use. Some 600,000 bales a year are being shipped from the Rivière de Loup bog.

When examined under a microscope, the peat is found to be composed very largely, but not entirely, of Sphagnum leaves and stems. The analogy of the partially rotted rope should perhaps be discarded at this point since the plant parts, although fragmentary, are quite well preserved. Sphagnum leaves are readily recognized because of their distinctive cellular structure. There are slender green cells scattered among larger, dead ones each of which has several round pores in the outer wall. The latter cells fill up with water very readily and serve as minute storage tanks. It is the countless billions of these microscopic tanks in a bale of peat that are primarily responsible for its value as a soil conditioner. As most gardeners know, Sphagnum is capable of holding ten times its weight of water, and the ratio is considerably higher with some species of this moss.

The fact that the peat consists chiefly of Sphagnum might sugest that the shrubby vegetation of heath plants is a recent invasion; however, pollen studies indicate that these plants have long been residents of the bog and have probably had essentially the same degree of dominance they now enjoy. The answer seems to lie, first, in the fact that Sphagnum and the other moss contributors grow faster and consequently contribute much more than is evident at first glance; and, second, in a more rapid decay rate for the leaves of the shrubs so that there is very little left of them by the time they become an integral part of the peat.

Careful studies of borings that have been made of this bog indicate, however, that its career has fluctuated somewhat during the past few thousands of years. Immediately overlying the clay some 25 or 30 feet down is a basal layer of peat in which the remains of a sedge *(Carex)* and a moss known as *Amblystegium* are dominant; above this are 1½ feet of almost pure *Amblystegium* peat; then comes two feet of sedge peat, and from that point on Sphagnum is the chief contributor, although at a level about 7 feet from the surface there are numerous tree stumps which indicate a dry period.

Both commerical and scientific interest in bogs, tundras and muskegs in Canada has increased tremendously in recent years and as studies of them continue we shall learn more of the ways in which they have developed and no doubt devise more ways to use the huge quantities of peat that are known to exist.

Last, but not least, for those of you who may one day find yourselves exploring this bog on your own, at the end of the day you will find dinner at the St. Louis Hotel in Rivière de Loup, a rare treat that will not be soon forgotten.

THE MAGIC OF HERBS

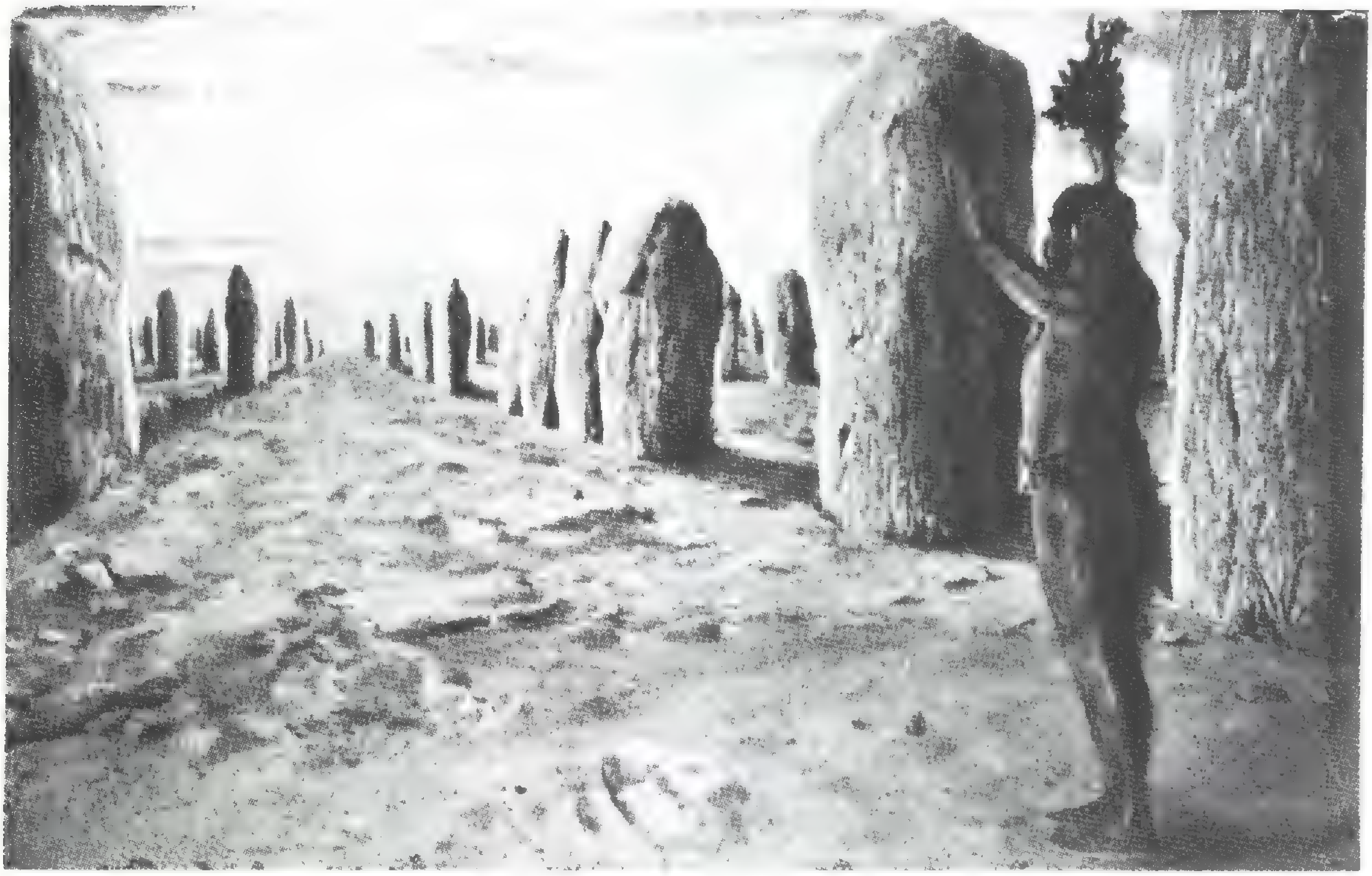
JOHN D. DWYER

THE word '"magic" conjures up a variety of ideas, bringing us to the land of fantasy, or on the other hand to, the shores of the deep and mysterious. It is only natural that man, whatever be the age or the circumstances in which he lived, should have found in the herbs, shrubs, and trees extraordinarily good stage-settings for his dreams and notions concerning the world around him. Perhaps in a bed of lowly pansies he imagines a sea of smiling faces or in the mighty oak towering over his home a symbol of danger and power. Using plants as food and shelter, as medicines (or even as poisons), as ornaments for his home and community, he often views them with a variety of mixed emotions, ranging from a reverence for their omnipotence in his life, to a love for the beauty they bring to the daily routine of living.

Let us reflect on a different environment, imagining an unsophisticated cave-man of 15,000 years ago lifting his moon-struck face toward the whispering forest. With his primitive intellect he reasoned that these trees were the agents of the gods, threatening him, warning him, that they were forces to be reckoned with, yes, even to be revered. How to control these baffling forces of nature which on one hand could be so helpful in providing food and shelter, while on the other hand could wreak such destruction as in fire or tornado, was of constant concern. For him the forces of nature were fickle, capable of harm in varying degrees, like the deadly effects of eating a few seeds of the mottled castor bean, or the annoying rash after touching the poison-ivy vine. Resident in the things of nature were forces beyond his comprehension; witness, for example, how a piece of peat-moss could pick up many times its own weight in water, or how the fruit of the witch-hazel exploded its fruit as if triggered by some elfin finger.

Worship and reverence for the living world about him was natural. We can imagine the cave-man holding aloft the sacred fruit of holly into the glowing face of the sun-god (fig. 1). For him this holly offer was a sacrament blessed by the sun-god and thus demanding worship. He is careful to set the plant between himself and the deity, as if he were afraid to tempt fate too far.

Thus nature represented not only a blessing but an incalculable obstacle with latent dangers at every turn. Those who appeared to possess unusual understanding of these forces were regarded as magicians and, when communities of peoples arose, were appointed to act as intermediaries between the ordinary folk and the unseen deities whose subtle influences guided the destinies of the fauna and flora. Throughout history these magicians have received various titles like "soothsayer", "medicine-man", "witch-doctor" etc. Thus the first



SUN WORSHIP

This scene shows how the stone alignments of Carnac, France, might have been used in ceremonies to welcome dawn by a farmer people living about 4000 years ago.

magicians of recorded history were priest-like in character and function. When science began to awaken in the Middle Ages in Western Europe after a 1200-year sleep, many of the pioneers were classified as magicians since they were probing the deep secrets of the stars, the forests, the stones, etc. Those who sought to gain control over nature for evil ends were regarded as "black magicians" co-operating with evil spirits.

The development of botany during the Dark Ages and Middle Ages was impeded by a great deal of ignorance, superstition, and magic. Despite the fact that the advent of Christianity had brought an immeasurable influence for good, man continued to interpret the plants about him as symbols of his religion, e.g. the clover or oxalis (wood-sorrel) leaf with its trio of delicate leaflets represented the Triune God, while the four-petaled mustard flowers immediately suggested the cross of Calvary. While such an interpretation was salutary, from a religious viewpoint it distracted the observer to a point where he had little interest in studying the plant for its own sake. The stylized sketches of many plants made during the Middle Ages are so poor that it is difficult to make out to which genus the plant belongs. Another element of distraction, existing long before the advent of Christianity, was the philosophy of Plato which recognized abstractions as the only "real" things and that stones and trees were merely shadows of these universals. This de-emphasis of the sense-experience with the things about him put man in the paradoxical position of sponsoring abstract principles without having gained data from actual sense experience with the plants. Considering some of the abstract types of research going on today in certain areas of science, we wonder whether we can be too critical of these medieval rationalizers.

Another influence of long standing was the so-called "Doctrine of Signatures" which William Cole in the "Art of Simpling" (1656) summed up: "The mercy of God maketh herbs for the use of man and hath not only stamped upon them a distinct forme, but also gives them particular Signatures, whereby a man may read, even in legible characters, the use of them." As we would suspect, man was particularly interested in relations seemingly existing between plants and the diseases of his own body. Thus plants with heart-shaped leaflets would be useful in treating cardiac conditions, or saxifrages, which obviously split rocks as they grew, were considered useful in breaking up gall-stones. Certainly shape and form were not the only signatures; for example the odors of plants, particularly of members like anise and angelica of the Umbelliferae, with their pungent strong aromas, were viewed as therapeutic. Consider today how many lay people consider that a medicine is not effective unless it has a strong odor or taste. Not the least of the signatures was the color of plants, such as saffron with its yellow blossoms which was considered effective in diseases involving bile. Yellow bile was considered for centuries to be one of the four basic humors which regulated the functioning of the human body.

At times the "Doctrine of Signatures" had to be dragged in like a Trojan horse to take care of associations which mushroomed and which had no tradition through the Dark Ages, e.g. when mercury salts were discovered to be effective in the treatment of syphilis, a disease first appearing in Europe at the end of the 15th century. The reasoning is interesting; as syphilis is a disease of the streets and market places, and since Mercury is usually the deity associated with thoroughfares and agoras, it was logical to suppose that the metallic salt named after him would be effective in such a social disorder. Sometimes such associations proved to be valid according to modern scientific studies, although the original rationale was faulty. Willow extracts were considered effective against rheumatism since willows thrived at or near water, the latter environment being considered as pre-disposing toward rheumatism. What we know as aspirin today (acetylsalicylicacid) may be readily extracted from willow *(Salix)* and is effective in giving relief to rheumatics.

One association (not an example of a "signature") which is difficult to understand from a historical viewpoint is that in which frogs and toads are related to mushrooms, particularly to the deadly *Amanita muscaria* (cf. Puharich's *The Sacred Mushroom*, p. 115. 1959). Recent researches have made it clear that the so-called "sweat glands" of an African toad and the flesh of the deadly Amanita have an acid in common, bufotenic acid. It is unlikely that the medieval alchemists had such knowledge of this acid.

Rituals involving plants and magic are older than recorded history. C. F. Leyel (Magic of Herbs, p. 90) points out, "In evocatory magic (and sorcery is one example) the precautions taken by the initiated are most elaborate. First of all a circle about nine feet in diameter is traced on the ground, and inside this, various symbols and crosses are drawn with a sword dedicated to these rites. Perfumes are burnt, solemn oaths and names are pronounced . . . Certain plants (p. 91) have always been associated with magic . . . and various legends are attached to such mythical plants as the Goose Tree and the Scythian Lamb.

"The Goose Tree or Barnacle Tree was thought to have arisen from fragments of wrecked vessels, which when washed ashore, sprouted into trees whose blossoms formed small deciduous birds; these on falling into the sea 'gathered feathers and grew to the size of a small goose.' "

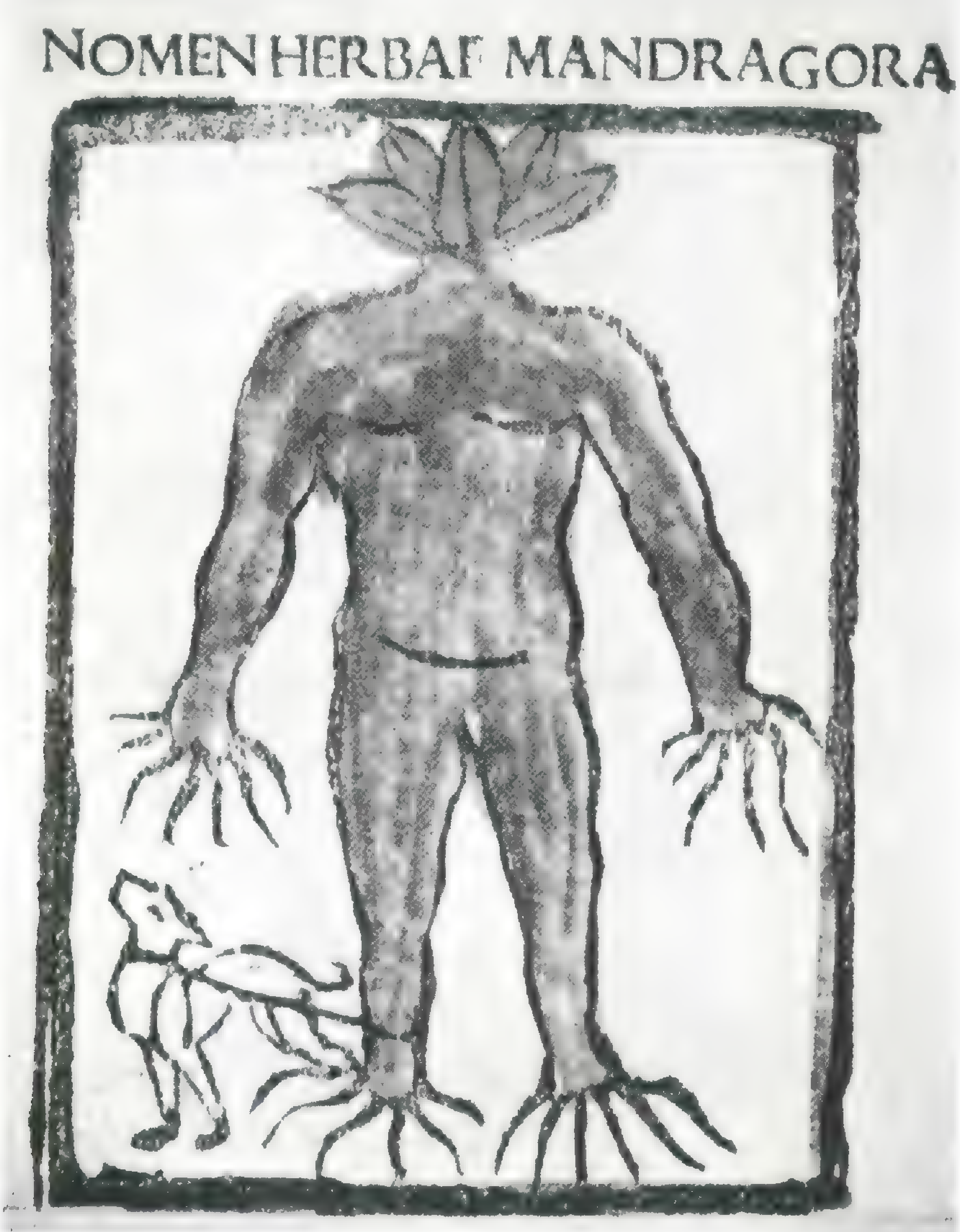
The Scythian Lamb of Tartary (cf. Alice Tryon's article Mo. Bot. Gard. Bull. p. 25, 1955) was supposed to be a lamb-like animal attached by an umbilical-like structure to the ground; this zoophyte was supposed to have developed from a seed "somewhat bigger and rounder than a melon seed" *(Parkinson's Herbal)*; this weird animal was supposed to have survived as long as it had herbs to feed within the area of its strange tether.

Perhaps the most fascinating of the magical plants was the mandrake of Europe (fig. 2) which for centuries was reputed to have properties of a human. Extracts from the plant were used as a narcotic. In the manuscript herbal of Apuleius Platonicus, a medical recipe book of the 15th century A.D., the collection of the potent principle from the plant is described: "When thou seeth its hands and feet, then tie it up. Then take the other end and tie it to a dog's neck so that the hound be hungry; next cast meat before him, so that he may not reach it, except to jerk the wort with him . . . take it immediately in hand and twist it, and wring the ooze out of its leaves into a glass ampulla."

It is difficult for people who are living in the sophisticated aura of our day to comprehend how so many people could be swayed for centuries by so much mumbo-jumbo and sheer nonsense. This harsh indictment has to be tempered somewhat when we consider that occasionally something that moderns regard as ridiculous, turns out to be very reasonable. For example, the notion in recent times that the application of saliva to a wound, long regarded as assisting in the healing process, was not effective; the recent discovery of a bacteria-destroying enzyme in saliva showed that there was some basis for this traditional belief.

There are many explanations for the perpetuation of myths, in any area of scholarship, especially the general ignorance of the masses in western Europe prior to the rise of medieval cities and universities, and before the invention of the printing press. Ignorance breeds an excessive play of the powers of imagination. Unlettered people with imaginations excited, fall an easy prey to those who reduce philosophy to confusion and religion to emotionalism. There were many in the medieval period who were expert at this. Lest we seem too critical, we must point out that it was in this same period that some of the greatest philosophers and saints were generated. The habit of the early people who could read and write, to rely on the authority of the ancients, especially on such unreliable sources as the Roman historian Pliny (23–79 A.D.) whose ear fell prey to every weird story circulated in the Forum, was bound to retard education. On the other hand, the tendency to set nature on a pedestal as an object of fear or admiration, without probing inside of it to get a real understanding, was detrimental to the advance of knowledge. Sincere scientists often labeled with the unsavory title of "magician" were driven into the alchemist's den where they had to compromise their yearning for the new science with the clap-trap of pseudoscience.

In conclusion, we must not dismiss the historical records of so-called science in the Dark Ages and Middle



"Mandragora" Mandrake (Herbarium Apuleii Platonici? 1484) from *Herbals, Their Origin and Evolution*, Agnes Arber, Plate V.

Ages as magical and mythical. Consider what happened when the distinguished ethno-botanist Wm. E. Safford in 1915 seemed to have consigned to oblivion the tradition that the upland Indians of Mexico ate hallucinogenic mushrooms, when he said that "the old writers had made a mistake," and that there never were any hallucinogenic mushrooms . . . and that the Spanish "padres" . . . had mistaken the "mescal buttons of peyote for mushrooms" [cf. *The Garden Journal* (N. Y. Bot. Gard.) vol. 8(1):1. 1958]. One of the most interesting sagas of ethno-botany in the last 25 years has been the discovery of such mushrooms, the actual witnessing of the Mazatec Indians of Oaxaca, Mexico, using these in religious ceremonies, and the tremendous interest in the possible use of the narcotic principle of these mushrooms in psychiatric research.

Thus the magic of superstition is often altered by the magic of modern science. Little did the primitive man, gazing over devastated fields of rotting plants and perhaps assigning the destruction to some curse of the gods, realize that one day scientists would find that some species under certain environmental conditions literally destroy themselves by toxic substances released from their root systems.

LIANAS FOR HOUSE PLANTS

JOSEPHINE L. DAVIES

Since the beginning of the fifteenth century, and perhaps even before that, we have been decorating our homes with growing plants. Eras have come and gone and we have progressed through various stages, from the humble culinary herb on the window sill to Aunt Maud's *Aspidistra* and the elaborate conservatories of the Victorian age. Nowadays with modern trends and large picture windows, people are taking a renewed interest in growing unusual house plants. New species are being tried which were previously thought to grow only in the greenhouse when away from their natural habitats. Foremost among these are lianas or tropical vines.

An interesting and beautiful group of plants, not often seen in homes, is that of the tropical flowering climbers. Many of them have brilliantly colored flowers. They grow rapidly, make effective house plants and add a new flare of decoration. A little extra time is needed to care for climbers but for those who like to grow something different and enjoy a little experimenting, these are worth the time and patience required.

Perhaps it would be easiest to start with the annual climbers. These are plants which are started from seed, grow rapidly and give a profusion of flowers within a short time, after which they must be replaced.

One of the best annuals to grow is

the "cup and saucer" vine, *Cobaea scandens,* with its cup of violet to rosy purple petals standing in a saucer of pale green sepals. The tendril tipped leaves make a delicate framework for a window. Although the vine grows rapidly it can be controlled by pruning out the wayward shoots. *Cobaea* grows well outdoors in summer and if the seed are sown in September it will flower equally well indoors during the winter.

The cheery bright orange flowers of the Black-eyed Susan vine *Thunbergia alata* will also provide color during the winter months if the seed are sown in the fall. It takes approximately three months for the flowers to develop from seed. Not all the species have black centers in the flowers. A packet of mixed seeds will produce blue, white and orange flowers. *Thunbergia gibsonii* has orange flowers which are twice the size of the other species and *Thunbergia grandiflora* has blue flowers.

Nothing can be so blue as the flowers of the Heavenly Blue Morning Glory, *Ipomea sp.* Unfortunately the flowers are ephemeral but new buds unfurl each morning exposing the large trumpets to the sunshine. The vines twine tightly up a cane or string and do not need to be tied. There are many other colors of Morning Glories, ranging through blue, red, purple, pink and white and there are variously striped ones.

Seed of these annuals grow readily but, if soaked in lukewarm water for twenty-four hours to soften the seed coat, the germination will be hastened. They should be sown about three to four seed to a six-inch pot containing a good soil mixture. After germination of the *Cobaea* and *Ipomea* choose the strongest seedling and remove the others. All the *Thunbergia* seed can be left to grow together in the pot. The plants of all of these can be left to grow to maturity in the same pot.

Among the perennial vines that can be grown indoors, one of the most interesting is the Passion Flower, *Passiflora sp.* This plant was first found by the Jesuits in South America, who gave it the name Passiflora because the strange and beautiful flowers reminded them of the Crucifixion of Christ. The ten parts of the perianth seemed to stand for ten Apostles, the crown of colored filaments resembled the crown of thorns, the five stamens were the five wounds, three stigmas repre-

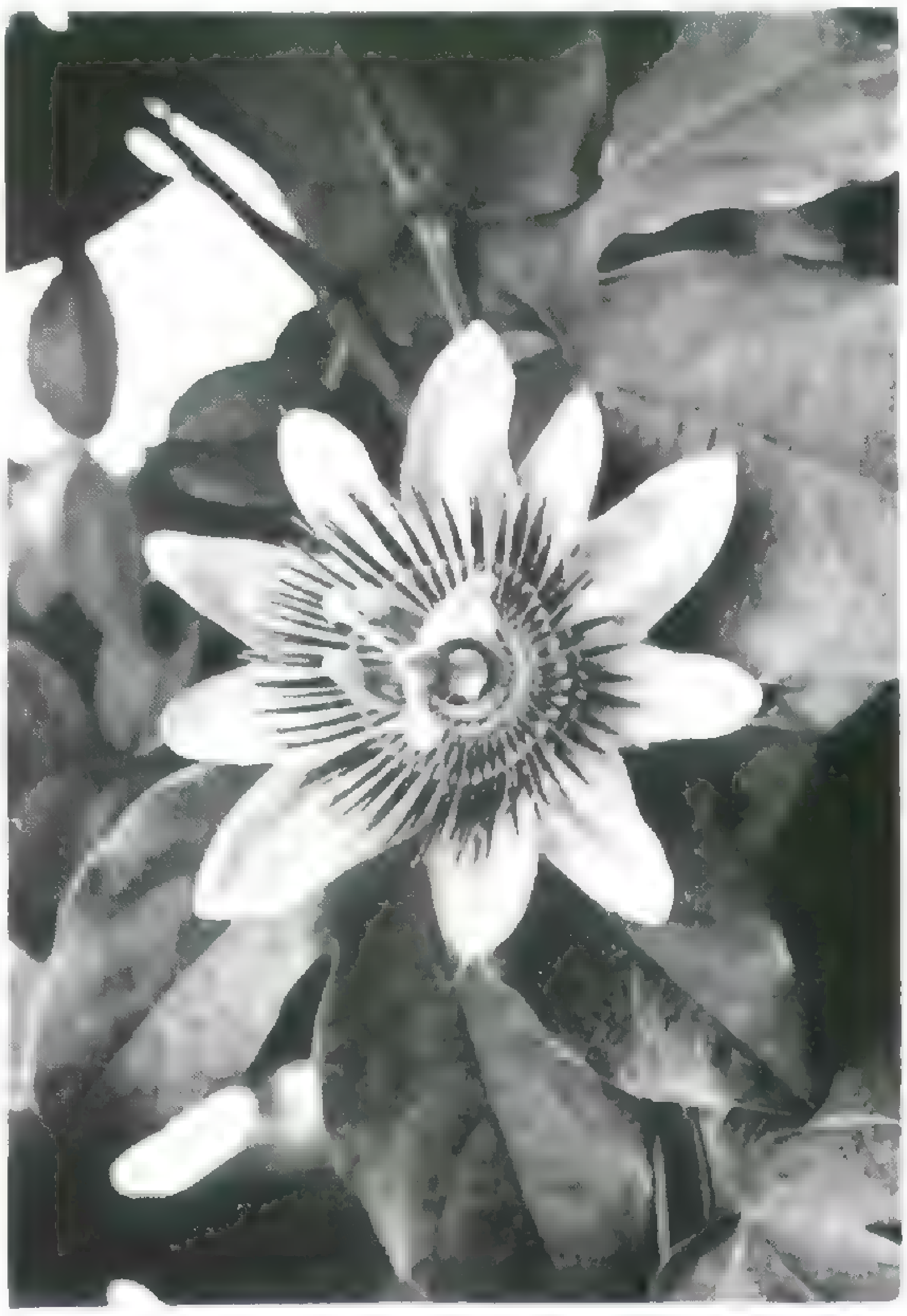


PHOTO BY P.A.K.

Flower of *Passiflora incarnata*

sented the nails, the long coiling tendrils looked like the whips or cords and the digitate styles resembled the hands of the persecutor. A few species such as *Passiflora caerulea, Passiflora mollissima* and *Passiflora incarnata* are adaptable to room culture. They vary in color from blue to pink or white. Seed of these plants can be obtained or new plants can be grown from cuttings any time from April to September. The Passion Flower should be grown in a large pot. It needs plenty of water during the growing season and should be fed with a liquid fertilizer, using the standard solution, as recommended on the package, once every three to four weeks. February is the pruning time when the weak shoots are cut out and the strong ones are shortened to about one third, or the whole plant may be cut back to two or three buds.

Wax flower, *Hoya carnosa*, makes an excellent and interesting house plant. The thick, dark green leaves are evergreen and the clusters of fragrant, pink and white star-shaped flowers hang their heads. This plant looks effective when grown around a window or twined about three bamboo canes in a pot. *Hoya* will root from the preceding year's growth if taken from March to May. The plant should be watered well from March to September and only moderately from September to March. A liquid fertilizer once or twice a year is sufficient. It should not be given any fertilizer when the buds are forming as this may cause them to drop off. The spurs on which the flowers are born must not be removed as it is on these that the next year's flowers are formed.

A climber that is always a conversation piece is the Glory Lily from tropical Africa, *Gloriosa superba*, and the name suits it well. The orange and red flowers with strap-like reflexed petals, resemble flames or a giant spider. They look very striking in flower arrangements. The *Gloriosa* is not difficult to grow, the small tubers being planted vertically, one to a six inch pot, in February. The pot should be watered moderately at first and then freely as the plant starts growing well. After flowering, the watering is gradually reduced as the leaves die. The soil is kept quite dry until February, when the tubers should be repotted into fresh soil. While dry, the pot may be stored on its side in a dark corner of the basement or a closet. Gloriosas will grow from six to ten feet tall and will twine around a bamboo cane or a trellis, but when young, the rather brittle stems need to be tied up. Like the Passion Flower, the Glory Lily will grow in a shady place but needs the benefit of a sunny window for profuse flowering. A few other species are also grown; *Gloriosa rothschildiana* which has red and yellow flowers; and *Gloriosa virens* var. *plantii* which has yellow flowers touched with red and which is slightly smaller and daintier than the others.

Two plants, native of Mexico, having brightly colored flowers and which need plenty of sunshine are Coral Vine, *Antigonon leptopus* and *Maurandia barclaiana.* Both Coral Vine and Maurandia can be grown from seed. Coral Vine has clusters of flamboyant, shocking pink flowers, more correctly inflorescences, triangular shaped leaves and climbs by means of tendrils. It should be planted in a large pot and watered freely during the growing season and but little during the winter months. Heavy feeding tends to produce many lush leaves and no flowers, so feeding two to three times a year should be quite sufficient. Maurandia has pretty trumpet flowers of blue, rose and white. It is a plant than can be used either as a trailer or a climber. It grows quickly and has glossy green ivy shaped leaves. It flowers best when its roots are somewhat cramped and therefore should be grown in a fairly small, that is, a four or five inch pot. Liquid fertilizer should be applied at two to three week intervals while the plant is in flower.

Windows other than sunny and south facing can be used for the evergreen leadwort, *Plumbago sp.*, which does not require the bright sunshine to flower. *Plumbago capensis*, the leadwort from South Africa has blue flowers while *Plumbago indica* is a lovely shade of rose. The fragrant white flowered *Stephanotis sp.*, so often a favorite for brides' bouquets, is another handsome plant which can be adapted for such windows.

Large windows with plenty of growing space and sunshine can be used for a very beautiful vine, *Allamanda cathartica*, belonging to the Periwinkle family. This vine has large, lemon yellow flowers with a waxy texture, and leathery, oblong, simple leaves. The Dutchman's Pipe vine, *Aristolochia elegans*, which comes from the river banks of Brazil, will grow in the same location. They both love plenty of sunshine and need to be kept on the dry side in the winter which is the rest period. They require severe pruning in the spring. The Aristolochia has pink, purple and white flowers whose shape resembles an old fashioned smoking pipe. This vine can be grown from seeds but they sometimes take a long period of time to germinate.

A few difficulties may be encountered when growing climbing plants. The actual cultural details are certainly no more demanding than for other flowering house plants. However, being natives of the tropics the plants do like a humid atmosphere. Often our homes, especially with forced hot air heating, are too dry, causing the leaves to drop off. This can be overcome by spraying the plants with water every day, a treatment which will also keep the plants free of dust. Humidity can be kept higher by immersing the pots of plants to a depth of two inches in a metal tray containing two or three inches of pebbles or gravel in which water is maintained. The water then evaporates into the air around the plants. Shallow vessels of water can be placed elsewhere in the rooms especially near the source of the artificial heat.

Light is an important factor and although some of these tropical vines will grow in subdued light, they nearly all need plenty of sunshine to flower properly. At least the flowering branches should be able to reach the sun. A south facing window is ideal. If you do not have such a sunny window then choose a plant such as Plumbago, Cobaea or Stephanotis which will grow in partial shade.

Vines will need a support on which to climb and sometimes need a helping hand to guide their direction of growth. Try to follow the plant's natural inclination and do not try to force a clockwise twining vine to grow counterclockwise lest both you and the plant become frustrated.

If you have a window with an unattractive view, a curtain of a climbing plant grown right across the window makes a pleasing screen and the sun will filter through the leaves giving a subdued light and cool effect. Passiflora or Cobaea can be used for this purpose. Vines can be attractive when framing a window, especially if the window is recessed and the plants are allowed to climb the walls of the alcove. They can be supported in various ways. A permanent structure such as a wooden trellis is very simple to make by wiring or nailing together bamboo canes or strips of wood. Most of the climbers grow at least six to eight feet and therefore the support should be tall enough to accommodate the maximum growth. Instead of being fastened to the wall, the trellis is sometimes suspended from a hook attached to the ceiling so that it may be easily removed for cleaning. Another method is to drive pins into the woodwork and stretch wire or nylon thread to which the plant can entwine or be attached. Chicken wire, cut into the desired size and shape and sprayed white, makes an attractive backing and support for the plant. Plants can also be grown up single strands of wire, string or thick wool thread, stretched between floor and ceiling. Raffia is best for tying plants because it stretches as the stems expand and so does not cut into them.

No climber, however vigorous, need get out of hand, for judicious pruning will keep it within bounds. Two to three strong stems, chosen and trained into position, are worth more than a tangled mass of small shoots growing in all directions. The majority of climbers will need pruning at least once a year and the time to do this varies with the different vines.

As these plants must remain in the same pots for some time, a good potting mixture at the start is necessary. If not available in your outdoor garden it can be obtained from a reliable horticultural supply firm. Should you want to prepare your own soil, a good mixture is one part sharp sand, two parts loam (good garden soil) and one part peat moss or leaf mold. Approximately one large tablespoon of bone meal per quart measure of soil will be sufficient fertilizer. Applications of liquid inorganic fertilizer can be applied every four to six weeks or as required by the particular plant according to the directions on the package.

Since climbers come from a variety of natural habitats, some may do well under the conditions of your home whereas others may fail. If one does not flourish, try another kind. All are certainly worth a trial. We have mentioned only a few of the more popular sorts of lianas. You may find it interesting to consider further varieties to find some particular one adaptable to your desire and situation.

BOARD OF TRUSTEES

Sam'l. C. Davis

ROBERT BROOKINGS SMITH, President of the Board of Trustees, announced the appointment of Howard F. Baer as a member of the board on December 18, 1959. Mr. Baer is President of the A. S. Aloe Company, and Vice-president of the Brunswick-Balke-Collender Company of Chicago. He is Director of the St. Louis Municipal Opera, Civic Progress, Inc., Blue Cross, St. Louis Union Trust Company, First National Bank, and is a member of the St. Louis Zoological Board of Control.

Mr. Smith also announced the election of Mr. Sam'l. C. Davis to the Board of Trustees early in 1960. Mr Davis is Vice-President of the St. Louis Union Trust Company.

PHOTO BY PETER FERMAN

ROBERT BROOKINGS SMITH (second from left), President of Shaw's Garden Board of Trustees, welcomes HOWARD F. BAER to the board after his election, while trustees HENRY B. PFLAGER (left) and LEICESTER B. FAUST look on.

BOOK REVIEWS

Grow Cacti. By Cyril Marsden. Cacticulture Series No. 1, Second Edition. St. Martin's Press, New York. 178 pages, 1958. Price $4.50.

Marsden's cultural handbook appears to be well written as it provides a wealth of information, especially for the beginner. Most of the chapters are extremely concise but nevertheless tend to convey explicit knowledge gained by the author over a period of years.

Cyril Marsden is a chemist by profession and this is quite evident in the analytical type of writing embodied in his chapters on composts, soilless culture, potting, watering and general care. In fact, he incorporates a great deal more on chemistry than most books of this type which have already been published. He apparently has done much research on nutrients and soil mixtures for cacti but I also have a feeling that he makes a complicated matter of this by suggesting too many formulas. After all, cacti are not as fussy as he would lead one to believe and I'm sure others will doubt the need for so extensive a selection of composts as he advocates. The group of chapters on classification, distribution, dictionary of botanical terms, common names and month-by-month review is a useful addition to this kind of book as it makes *Grow Cacti* one of the most complete volumes of its kind written to date.

There is a brief chapter on photography in which the author states that "it is easier to take poor, than good photographs of cacti" and he certainly proves his point as some of the illustrations in the book could easily have been left out. Both the monochromes and the color pictures lack sparkle and the subjects are often lost in a fuzz of poor definition.

—Ladislaus Cutak

Venezuelan Orchids Illustrated, vol. 1. By G. C. K. Dunsterville and Leslie A. Garay. Andre Deutsch Ltd., London. 1959. 448 pp. $15.00.

Anyone who attempts to identify orchids or deal with orchid nomenclature soon learns of the difficulties in this field. There has been little systematic (monographic) study of the family. The published descriptions are often vague and contradictory, museum specimens of the orchids are much too few, and even when these are available, the crushed and dried flowers are none too informative. One finds that a detailed drawing prepared from living plants is often the best substitute for the living plant itself. In this volume we have very nearly the ideal arrangement. A highly skilled artist has prepared the drawings from living plants and (should the botanist seek some detail which the artist overlooked) museum specimens have been prepared of these plants in each case. Careful descriptions and locality data accompany the drawings, so that they have the highest possible botanical value. This volume should do much to still the cry of "but what can I do? I'm just an amateur." This beautiful work is pre-eminently the work of an "amateur" and has been accomplished in the relatively short period of seven years. Clearly, the "amateur" is limited only by his own energy and inclinations.

The introductory pages are brief, and include a general discussion of the orchid family, its relationships and flower structure. Of special interest is the section on variation within species. Only recently have we begun to appreciate the fact that the orchid species are populations of many individuals in nature. The specimens which we observe in the greenhouse and museum are at best very small samples of the natural population. The orchids illustrated here were identified by Leslie Garay, using the extensive facilities of the Orchid Herbarium of Oakes Ames, so that the names used are as correct as is possible at this date. Synonymies are given, which greatly increases the value of the work for botanist and amateur alike. The authors have tried to avoid unnecessarily complex terminology, and a glossary is provided for those more or less technical terms that are used.

The book is published in London, though the actual printing was done in Holland, and is of high quality throughout. Some typographic errors are to be found, largely, one suspects, the inevitable result of having the publisher in Europe and the authors in Venezuela and the United States. Very few of the errors are serious, though the repetition of the same footnote with each of the 200 descriptions seems a bit superfluous. The 200 full page drawings represent 67 different genera, and many of the species are here illustrated for the first time. The sixteen color photographs in the introductory section are uniformly excellent and well reproduced.

We are told that further volumes are to be published in this series. It is probably too much to hope that all of the thousand or more species of Venezuelan orchids will eventually be illustrated, but in any case every volume will be eagerly sought by all true orchid lovers.

—Robert Dressler

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MISSOURI BOTANICAL GARDEN PROGRAMS

Special Shows and Displays:

Daffodil Show April 8 and 10

Easter Display April 17

African Violet Display May 7 and 8

Spring Flower Show May 21 and 22

Free Nature Programs for children, aged seven and over, are held every Saturday morning from 10:00 to 11:30 A. M.

Sowing Seed for Your Garden April 2

Flower Shapes and Names April 9

Hunting for Hidden Flowers April 16

Spring Safari April 23

More About Your Garden Seeds April 30

Plants from Prehistoric Times May 7

Planting Your Garden May 14

Color Sound Movies May 21

Plants with Wet Feet May 28

Free summer programs of nature study for children are supported by a gift from the Pitzman Foundation. Trails, craft work, and group activities are offered. Schedules of these programs may be obtained in June at the Main Gate.

Courses

The following courses are open to any interested person. Certificates are awarded upon the successful completion of any course.

Information on registration may be obtained by calling

PRospect 6-5567

Please send all registration fees to

Missouri Botanical Garden
2315 Tower Grove Avenue
St. Louis 10, Missouri

Registration fees cannot be refunded after the last day of registration for any particular course.

The courses will meet in the classroom of the Garden's Museum Building.

To reach the Museum, enter the Garden through the walk-in gate opposite Cleveland Avenue at 2221 Tower Grove Avenue, the building on the left.

Botany

Course 101. Spring Wild Flowers of Missouri.

Place: Museum Bldg.

Time: Five Monday nights, 7:30 to 9:30 P. M., starting April 11.

Fee: $15 for the five sessions.

Enrollment: Limited to 18 students. (Additional sections will be opened if necessary.)

The aim of this course will be to teach basic flower terminology and the use of Steyermark's "Spring Flora of Missouri" by examination of as many different species of native plants as possible. At least one class meeting will be a field trip to the Garden's Arboretum at Gray Summit on a Saturday afternoon. The flowers studied will include representatives of shade trees and shrubs.

Two small texts will be provided; more comprehensive treatises will be available.

Instructors: Dr. N. H. Nickerson, Dr. Robert Dressler.

Course 103. Ferns of the St. Louis Area.

Place: Museum Bldg.

Time: Five Thursday nights, 7:30 to 9:30 P. M., beginning April 28.

Fee: $15 for the five sessions.

To the person interested in unusual plants, ferns offer a unique opportunity; with relatively little effort, one may become acquainted with all species native to a particular region. This course includes some details of fern structure and life history, methods of recognition of species native to the area, and observations on environmental situations in which individuals of the various species may be found and grown in living collections. One class meeting will be a field trip to the Garden's Arboretum at Gray Summit on an afternoon to be mutually arranged. No previous knowledge of ferns is required.

Instructor: Dr. George Bunting.

Course 123. Modern Horticulture for Home Gardeners I.

Place: Museum Bldg.

Time: Five Wednesday nights, 7:30 to 9:30 P. M., starting April 20.

Fee: $15 for the five meetings.

Enrollment: Limited to 20 students.

The material to be covered by this course will complement the subject matter in Course 128. Each course may be taken independently. Subject matter includes discussions on shade trees, shrubs, evergreens, lawns, house plants and greenhouses. Each evening will feature both practical and classroom work. Students may take home plant material at the end of each meeting.

Instructor: Mr. Robert J. Gillespie.

ORCHID CULTURE

Course 141. Orchid Culture in Home and Greenhouse.

Place: Museum Bldg.

Time: (Register for only ONE of the sections offered.)

Section I.—April 16, 10:00 A. M.

Section II.—April 23, 10:00 A. M.

Fee: $10 for one meeting.

Schedule:

10:00 A. M.: Orchids suitable for home culture and the best ways of growing them. Potting demonstrations.

12:00 Noon: Lunch. Garden supplies coffee and soda.

1:00 P. M.: Growing orchids in unusual containers in the home. Basket slabs, poles, and the like, with examples and demonstrations of potting and care.

2:00 P. M.: Inspection of greenhouses.

3:00 P. M.: Individual potting instruction by members of Orchid Department staff. Students may take potted plants home.

Instructor: Mr. Robert J. Gillespie.

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SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at TOWER GROVE, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the TOWER GROVE mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. spring to fall and until six in the winter time though the greenhouses close at five. TOWER GROVE, itself, Mr. Shaw's old country home, is open from one until four, admission fifty cents, with special guides. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one most used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southhampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 A. M., but is closed on Saturdays, Sundays, and holidays. The Cleveland Avenue gate, 2221 Tower Grove, is nearly always open, and there is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., State Highway 100 adjacent to Interstate Highway 44. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.

MISSOURI BOTANICAL GARDEN

Bulletin

May 1960
Volume XLVIII
Number 5

COVER: Fountain in the Garden Wall of the National Council of State Garden Clubs Headquarters. Photo by Martin Schweig.

The fountain was designed by Mr. William Talbot of Washington, Connecticut. He is a graduate of the Pennsylvania Academy of Fine Arts in Philadelphia, where he was the unprecedented winner of two top awards—the Cresson Award and the Prix de Rome. The National competition conducted by the Artists Guild in St. Louis awarded him first place. Mr. Talbot also created a fountain for the Library in Fitchburg, Massachusetts. He is a member of the Architectural League and Sculptors Guild of New York City.

CONTENTS

Epiphytes
Our Good Neighbor
Summer Flowers for Winter Bouquets
Try Gourds in Your Garden
Missouri Botanical Garden Programs

◆

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Missouri Botanical Garden Bulletin

Vol. XLVIII No. 5 MAY 1960

EPIPHYTES

F. W. WENT

WE propose to reproduce the vegetation of several different tropical regions in the Climatron. This means that there will be typically tropical plants such as palms, pawpaws, banyan trees, bananas, fragrant frangipani, carrion flowers, lacy tree ferns and giant gunneras. In addition to these specific tropical plants, large and small, there will be plantings of certain plant groups largely restricted to the tropics, which are the lianas and the epiphytes.

Any plants which do not have a massive trunk to lift them above the gloom of the surrounding dense vegetation would not seem to have much chance in the tropical jungle, which is one of the densest forests in the world. Many ferns and mosses can grow even in the eternal dusk of the jungle bottom, but most other plants need much more light to thrive. The problem is—how do they rise above the darkness of the forest floor without a tree-like trunk?

There are three solutions to this problem:

1. Climb rapidly up to the top of the jungle giants by means of tendrils, aerial roots, or twining stems. This is the habit of the tropical vines or *lianas*.

2. Attach themselves to branches of a jungle giant obtaining water by sucking it from the hosts since they cannot get it with their own roots from the perpetually moist forest floor. This is done by the tropical mistletoes, which are parasitic on the tree branches to which they attach themselves and into which they bore with their rootlike suckers. These are called *parasites*.

3. Attach themselves to the branches of trees, without parasitizing them, but employing diverse methods to gather or retain water and nutrients. Such non-parasitic plants use tree branches solely for support, and for a place in the sun. These are called *epiphytes*.

In the course of the years many lianas and mistletoes will be growing in the Climatron, but that takes time; the lianas must have trees as support, and the mistletoes need full-grown living trees for their water and food supply. But from the opening day on we can have a good display of epiphytes. During the many years that there were greenhouses at Henry Shaw's garden, epiphytes were grown in them. Many of the spectacular orchids, most of the beautiful ferns, and practically all bromeliads are epiphytes.

As mentioned earlier, epiphytes are plants which grow on trees for support, but which remove no nutrients or food from the trees on which they live. They cover the branches of the tree, and, therefore, people may think that they are parasites. Yet, this is not the case at all. Therefore, the name "space parasites," which is often used for them, is slightly misleading.

Epiphytes are most common in the tropics. In rain forests particularly, trees may be so completely covered with them that the branches themselves can no longer be seen, and sometimes the branches break under their load, like trees in temperate climates may break under snow or ice loads. In the temperate zones, only small plants, usually mosses and lichens, are found as epiphytes, but, in the tropics, most orchids, many ferns, most bromeliads and occasional representatives of other families occur as epiphytes.

It is obvious that epiphytes or air plants living on the branches of trees have special problems in getting enough water and nutrients, without which no plant can grow. Most jungles exist in areas with abundant rainfall, yet in all of them there are sometimes periods of one or more weeks' duration when there is no rainfall, and then the epiphytes are in difficulty. Since they have no roots which grow down to the ground, they have available only the water which reaches them during the frequent rainstorms. During dry periods they must rely on the

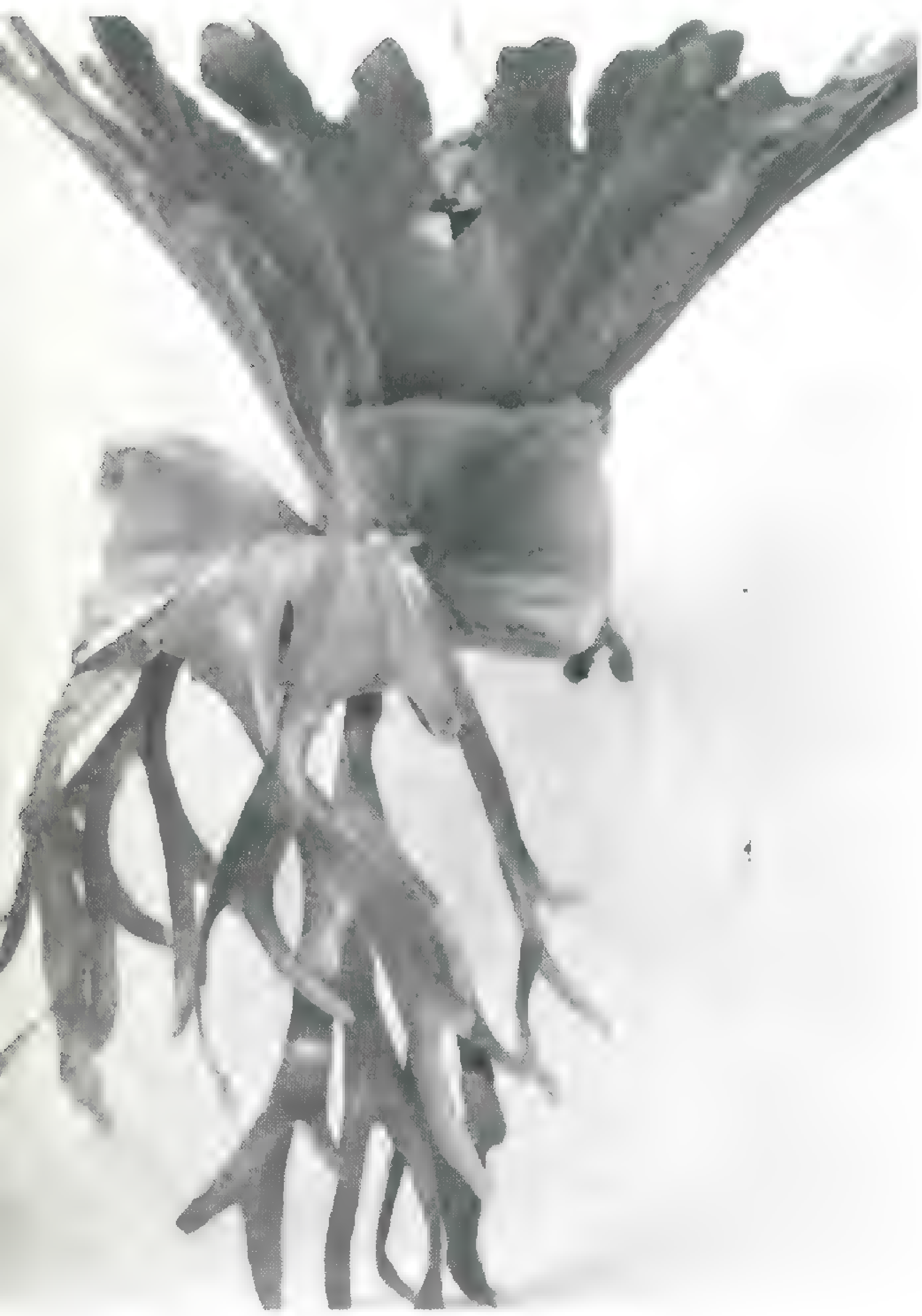
Epiphytes "ride pickaback" on trunks of jungle giants for a place in the sun.

water which is stored in one way or another. We find, therefore, that the better-adapted epiphytes have special mechanisms by which they can store water, or by which they have access to free water. The less well-adapted epiphytes, such as mosses and lichens and even a few ferns, which have no special storage facilities for water, either are able to dry out completely and survive, or they live only in the wettest forests where a sufficient amount of moisture is always available.

The water can be stored either inside the tissues of the plant, such as in the pseudo-bulbs of orchids, or in huge masses of humus which are accumulated by the plants. A very good example of such humus collection is found in ferns. For instance, the bird's-nest fern *(Asplenium nidus)* forms a sort of basket with closely packed leaf bases in which it collects dead leaves which drop off the host tree. These leaves in the basket retain a large amount of water which is then available to the fern because its roots penetrate this mass. At the same time, as the leaves decay, humus is formed which supplies the nest fern with nutrients. Thus the nest fern has a simple, but very effective, means of being continuously supplied with water and nutrients. At its base it simply forms a basket in which all the necessary humus collects. In the bigger nest ferns these humus masses become so huge that the largest earth worms in the world are able to live in them. Obviously, it takes a lot of leaves to supply a two-feet long earth worm with food.

A similar principle of collecting water using the bases of leaves, but in a more complicated form, exists in the Bromeliaceae, the pineapple family. With only few exceptions these plants are epiphytes, and most of them have their leaves in rosettes, and grow rigidly erect. The leaves are almost metallic, and their bases fit so closely against each other that rainwater collects within them. Whereas, the leaf blades are very leathery, and where they connect with the base, they can readily absorb water. In this way each Bromelia, Nidularia or Aechmea stores sufficient water supply and can easily live through one or two weeks of drought. Where water pools exist between the leaf bases water insects such as mosquito larvae live, and to combat malaria during the construction of the Panama Canal, the trees around the construction zone were all

A Bromeliad with its rigidly erect rosette of leaves.



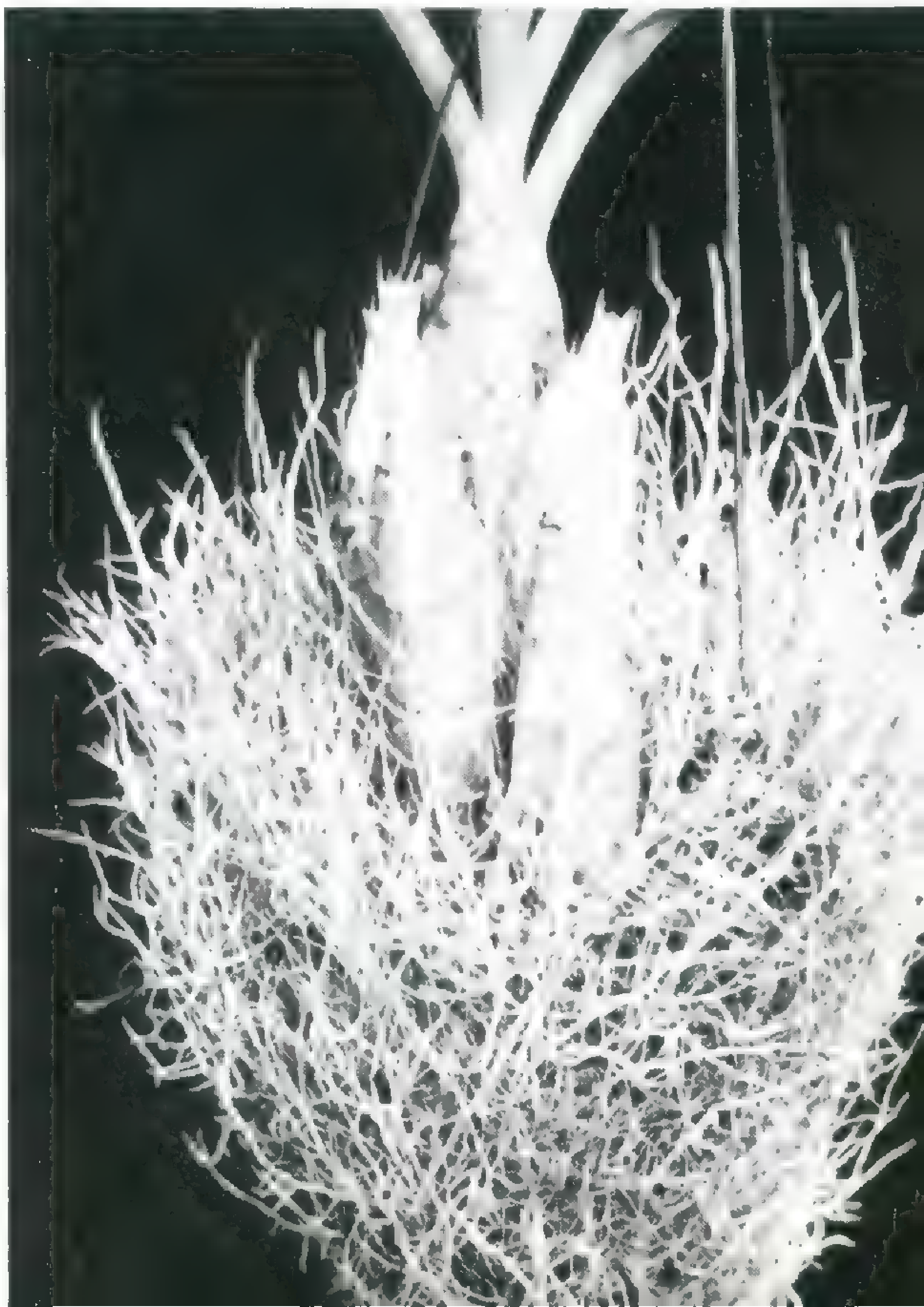
Staghorn-Fern

The nest-like habit of growth and the two types of leaves.

felled to get rid of the bromeliads thus eradicating mosquitoes.

In the case of the staghorn fern, the same result is attained, but by different means. The staghorn fern, which can become as large as a bird's-nest fern, has two types of leaves—one is the ordinary type which hangs down, remains green and supplies food through its photosynthesis. The other type of leaf is upright and partially envelopes the branch on which the plant grows. These upright leaves form a basket which again can collect the leaves so that humus is available for this huge fern. This, of course, is slightly more advanced in that the plant has two different types of leaves—sterile and fertile, whereas, in the case of the bird's-nest fern, the ordinary leaves act so as to form a basket.

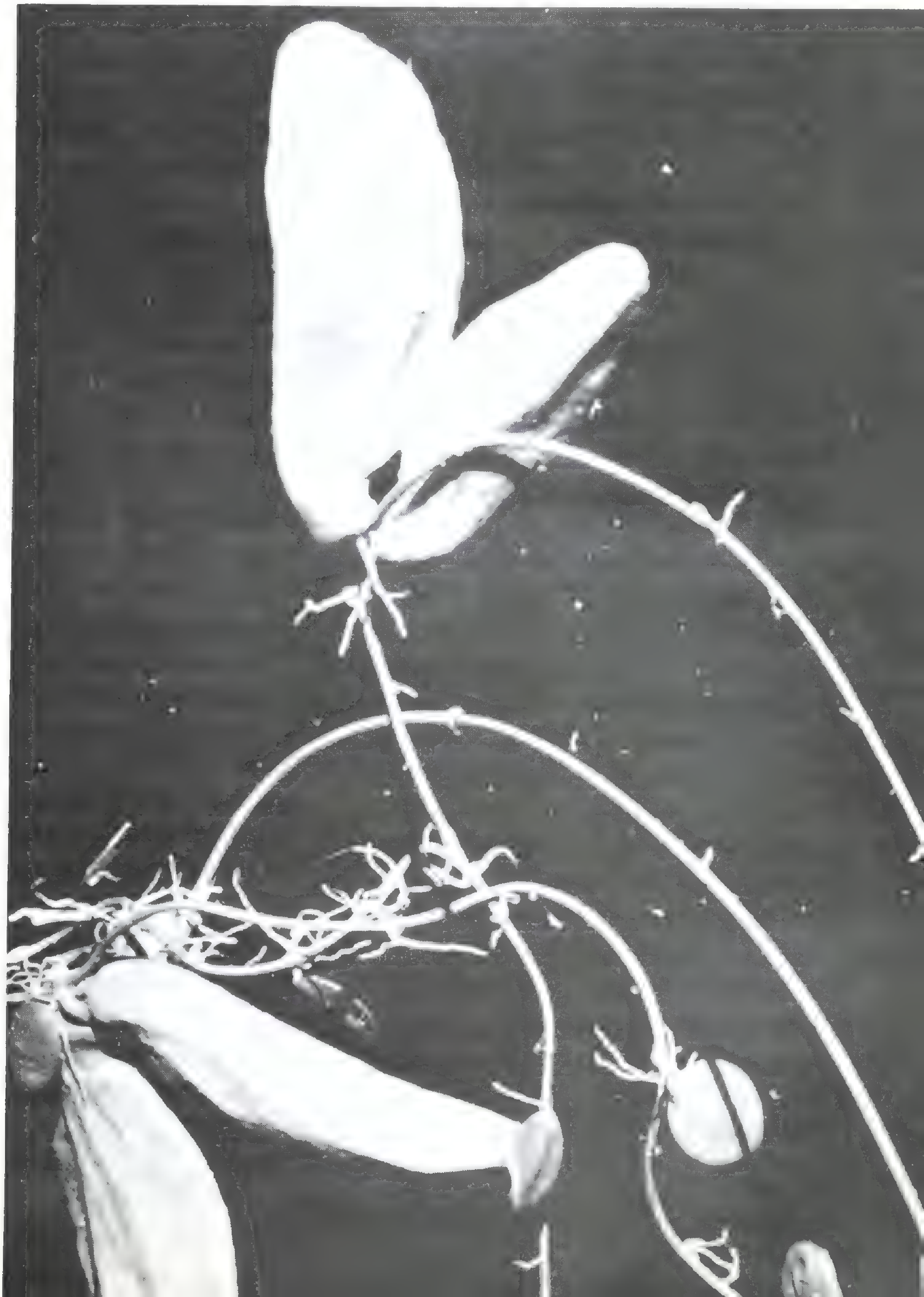
Another method of collecting humus is exemplified by a number of orchids, and especially the large ones, such as epiphytic Cymbidiums and the gigantic *Grammatophyllum speciosum*, which has ten-foot long stems and eight-foot long inflorescences. These orchids have ordinary roots which surround the branch on which they grow and which support the plant. In addition, they form a second type of root which grows upward and soon dies, thus acting as a sort of pitchfork which spears dead leaves as they drop from the host tree so that again humus is accumulated around the base of their stems.



An Orchid with its pseudobulbs and the pitchfork like modified leaves which grow upward to catch and hold materials for humus.

The most refined method of water collection by an epiphyte is found in *Dischidia rafflesiana* belonging to the milkweed family. This plant has long trailing stems, which are only occasionally attached to branches by weak rootlets. It has perfectly normal, small, opposite, succulent leaves. Its peculiarity lies in a second type of leaf which it produces. These leaves are

The Epiphyte *Dischidia rafflesiana* showing both the small normal leaves and the larger specially adapted pitcher type leaves.



also opposite, but are much larger and have the form of pitchers with a small opening where they fit to the leaf stalk. Through that opening not only the inside of the pitcher is in contact with the outside, but also an aerial root enters the auricle-shaped pitcher. When the pitcher hangs down, with its opening up, rain water can run into it, and that water is available to the plant during dry period by means of the root inside. But the pitcher opposite the hanging leaf points upward, with its opening down. In this pitcher we invariably find an antnest. These ants let their refuse lie around, and the root inside the pitcher can absorb nutrients from their droppings.

There are quite a number of other epiphytes which have hollow stems such as orchids, or rhizomes such as ferns in which ants live. Most peculiar among these ant epiphytes are *Myrmecodia* and *Hydnophytum*, members of the coffee family. Their stem base is swollen to a large, sometimes even huge, tuber which is provided with a system of hollows and corridors particularly adapted as antnests.

In all these plants special structures provide room for ants, and the untidier the ants are, and the more refuse they bring to these epiphytes, which otherwise would live under starvation conditions, the better the plants are. Here it pays for the tenants to neglect their rooms, and thus provide food for their landlady.

After their seeds get caught in cracks of the bark, or in moss cushions on the branches of trees almost all epiphytes start as tiny seedlings. While very small, they do not need a firm attachment. But later, as they grow larger, they form roots that encircle the branch with which they can support themselves. We often find two different kinds of roots in these epiphytes: those which encircle the branch, soon die, providing only attachment; and the feeder roots which follow along the branch and seek pockets of humus.

There is one epiphyte which never forms any roots, and remarkably enough, this is the most successful of all. It is the Spanish moss, *Tillandsia usneoides*. It hangs down in garlands from trees all over our South, from the Carolinas to Tennessee, to Florida, and through the jungles of South America. This plant scarcely looks like a higher order of plant. It consists of long gray stems with gray linear leaves which are draped over the branches of trees. Special hairs with which stems and leaves are covered, collect and absorb water as it runs off branches of the host tree during a rain, and in which minute amounts of nutrients are present, dissolved from the host. The more cells of the host which die, the more nutrients in this run-off water, and the better the Spanish moss grows. It does not kill trees, as is often claimed, but it grows best on dying trees. However, it does not thrive on telephone wires or other structures which do not give off nutrients.

A branch of a tree is a very peculiar spot for seeds to reach and to stick to. Therefore, epiphytes must have special adaptations so that their seeds (or spores in the case of ferns) become attached to branches, instead of dropping to the ground. These adaptations have gone in two directions:

1. Seeds or spores are produced in such enormous quantities making it possible for one to occasionally get attached on a branch in an advantageous spot. Fern spores are produced by the millions by each plant. For instance, one single leaf of a bird's-nest fern may produce ten million spores, and with the total of a hundred leaves per plant, this means that each germinated spore could give rise to a plant which would multiply this spore a billion times. Most ferns have a further mechanism by which the sporangia in which the spores are formed open only when the weather is dry, so that the spores which are ejected may be carried away by wind, and not get precipitated or washed away immediately by rain.

Orchids are plants which reproduce themselves by the germination of their seeds. Orchid seeds are also formed by the millions by the mature plant. A seed pod of an orchid contains anywhere from ten to one hundred thousand seeds. These are very light. The tiny seed is covered by a thin membrane, the seed coat, which acts as a sail. Orchid seeds are so small that they consist of less than a hundred cells, which are not differentiated. Because of their smallness, they do not contain storage food, and, therefore, the seedlings have to live symbiotically with a fungus which supplies the necessary food for about one year's time, until a root and a leaflet are formed which then can take over the food supply for the plant.

2. Another group of epiphytic plants has much larger seeds, which are imbedded in a fruit which is eaten by birds or other animals living on trees. These seeds pass through the intestinal tract of these animals and have a good chance to become deposited, in the droppings, on the branch of another tree. This happens, e.g., with the fig seeds, and also with many epiphytic members of the blue-berry family. Many bromeliads have juicy fruits such as pineapple; and so have Araceae as in the Calla Lily family, and Rhipsalis, an epiphytic cactus.

Thus we have seen that epiphytes have many interesting and effective adaptations to have access to extra water and food, to attach themselves to the branches on which they live, and to get their seeds or spores deposited in the right environment.

There is another group of epiphytes which is always found in certain ant nests in trees in the tropics. Such ant nests are called ant-gardens, which seems a very appropriate name. They can be recognized from afar as green clumps, much larger than most other epiphytes. The fruits of the plants living in these ant nests are collected by the ants for food, often because they are rich in oil. The seeds which are not eaten, and which the ants leave in their nests, germinate and send their roots through the ant nest. This fortifies the nest, and the droppings of the ants provide food for the new plants. This is a perfect case of symbiosis between ants and plants, each benefitting from the other.

* * *

OUR GOOD NEIGHBOR

One year ago in May, our "Good Neighbor," the National Council of State Garden Clubs—familiarly known as the National Home—celebrated its 30th anniversary and dedicated its new home on Magnolia Avenue. During the past year the Missouri Botanical Garden and the National Home have enjoyed a mutually pleasant and profitable association, and look forward to continued and increasing cooperation.

The National Council is presently composed of 47 State Federations and the District of Columbia, 14,171 clubs and 415,852 members. All work and services are on a volunteer basis, with the exception of the Headquarters Staff. In addition, the National Council proudly recognizes as Affiliate Members, 16 horticultural organizations throughout the world; from Canada to Mexico and to South America; from Bermuda to South Africa and to Australia.

The work of the National Council is set forth in its purposes, which are as follows:

To co-ordinate the interests and activities of the State Federations of

Upper terrace of the National Home

Patio of the National Home

Garden Clubs together with similar organizations in foreign countries.

To aid in the protection and conservation of natural resources, and to encourage civic beauty and roadside development.

To assist in establishing and maintaining botanical gardens and horticultural centers for the advancement of science.

To advance the fine art of gardening through the study of horticulture and landscape design, and to assist deserving students, by means of scholarships, in these fields of endeavor.

To co-operate with other agencies furthering the interests of horticulture, conservation and beautification.

The new National Home is built on land formerly a part of Shaw's Garden. In the future the Garden and the National Home will work very closely together in the development of the grounds where they adjoin. In the Master Plan now developed for the Missouri Botanical Garden, no separation of grounds is contemplated, and we envisage that the landscaping of these grounds will be treated as a unit. Thus we will be "Good Neighbors" in the finest sense of the word.—E.L.E.

SUMMER FLOWERS FOR WINTER BOUQUETS

GEORGE S. BUNTING

Many of us like to have flowers in our homes the year round. In summer, of course, we can just walk out into the garden and cut a bouquet. But in winter, the chief source of cut flowers is the florist, and when we think of the cost of a few blooms, we often decide that the price is limiting. Some of us, therefore, settle for winter greenery or foliage plants, while others turn to—dare I accuse a gardener of it—artificial flowers! Actually, it is easy to *grow* flowers for winter bouquets in your own garden during the summer. There are several kinds of flowers that have the capacity to be dried and still retain much of their original color, shape, and beauty. Not only can these flowers be arranged into attractive winter bouquets, but they can also be an important part of your summer garden, furnish color and cut flowers during the growing season.

Most of us are familiar enough with the woody plants that produce attractive dried fruits for winter bouquets, such as the lovely bittersweet *(Celastrus scandens)*, wax myrtle or bayberry *(Myrica* spp.*)*, and the Japanese barberry *(Berberis thunbergii)*. But there are several annuals and a few perennials which, planted in the spring, will produce flowers the same or the following season. Most of them are old favorites well known to our grandmothers but no longer popular, having given way to newer introductions. Some of the best flowers for summer as well as winter beauty are discussed below.

Gomphrena globosa. The "prettyboys" of grandma's garden.

GOMPHRENA GLOBOSA

The globe amaranth, in past decades known as prettyboys, is of outstanding merit. It forms a dense plant about 18 inches tall, and nearly as broad, virtually covered with dense globular heads of magenta, or of pale pink or white, about ¾ inches across. Flowers are produced all season, and the plants are excellent for bedding, or they may be spaced occasionally about the garden for a spot of color here and there. In this latitude globe amaranths will often seed themselves, and seeds saved from plants grown year after year may give good results. Each flower head is borne on a straight stem 6″ or more long, and often three such stems arise from one joint. For drying, it is desirable to cut the stems just above such a joint, otherwise the stems may collapse at that point upon drying. The heads should be cut when the flowers are at their peak of beauty and expansion, tied into bunches, and hung upside down in reduced light until completely dry. (The attic is usually a good place.) Select only the best heads on the longest stems for drying, and continue to cut and dry more as they are produced throughout the season. The beauty of the plants will not be affected.

HELICHRYSUM BRACTEATUM

One of the most attractive species for dried bouquets is the strawflower. It is, however, the least showy garden subject discussed here. The plants are often quite slender and up to 4 feet tall, and bear the flower heads mostly on long stems at the top of the plant. Each plant produces many heads of either golden or rose. It is important to plant the seeds early, for the plants are rather slow to start. But even a few plants well grown can make sufficient flowers for several showy bouquets. The secret to good dried strawflowers is to cut them when they have enlarged, but before the bracts (the colored petal-like structures) begin to open. Even some smaller "buds" will be attractive in your winter bouquet. To dry for winter use, cut the stems as long as you desire them, remembering that for arrangements it is often best to have just one flower head per stem. Remove the leaves from the cut stems, tie the strawflowers into bunches, and hang them upside down away from strong light until completely dry. Cut a few heads frequently as they reach the proper stage of development. If the heads are too mature when cut, the center part will "shed" upon drying.

Similar to *Helichrysum* is Acroclinium *(Helipterum roseum)*. The plants grow to about 24 inches tall and produce rose or white heads about 2 inches across. They may be treated in the same way as the strawflowers.

LIMONIUM spp.

Statice (the final "e" is pronounced) seems to be rarely grown in the home garden these days, yet surely deserves a place. There are at least three species offered for sale, and they come in a variety of colors from purple and lavender to pink and white, and also bright yellow. They require no special treatment other than giving them a sunny location. *Limonium bonduelli* is the yellow-flowered one, and grows to 24 inches tall. It may be treated as a biennial, or if started early enough, flowers may be produced in one season. A bright pink-flowered species, *L. suworowi* is an annual that grows about 18 inches tall. By far the most widely grown sort is *L. sinuata,* a perennial species up to 30 inches which may be had in shades of pink or blue, and white. The flower stalks of none of these species are large, but they are very showy. They may be cut as desired, and dried in the vase or otherwise.

CELOSIA ARGENTEA var. CRISTATA

An old favorite is cockscomb, today enjoying new popularity because of the new short-stemmed (12 inches) strain which lends itself to bedding. Of course, the tall strain is still available. Both have equally large heads, and either will serve well for winter bouquets. The plants need no special attention, but undoubtedly will make better plants when properly fertilized. Cockscombs should be cut and dried before the seeds mature to prevent the otherwise endless dropping of seeds thereafter. Until they are dry, they should be hung upside down in reduced light. It is true that the color of cockscombs will sometimes fade a little after drying. By trying out different times of cutting and methods of drying, you will learn how to obtain the best results.

GYPSOPHILA PANICULATA

Babysbreath can be used as a filler in the garden, and in cut bouquets when fresh or dried. The numerous small white flowers are arranged on a many branched stalk to 36 inches tall, usually produced in June and July. It is a perennial, but early planting may give flowering material the first year. The cut stems should be hung upside down while drying. Remember that they are brittle when dry, and

Gypsophila paniculata. A lacy touch to both garden and bouquet.

one should perhaps take the precaution to hang each stalk separately, if they are to be combined in various bouquets later.

GRASSES

There are several ornamental grasses which produce attractive heads on long stalks, and that can add much to the charm of a dried bouquet. Several of these are perennials, a few annuals. Typical of the grasses, they need no special care except to be given room enough to develop. The perennial grasses are usually started from divisions, which are very easy to transplant. Seeds are, however, offered by some dealers.

Zebra grass or Eulalia *(Miscanthus floridula)* is a large perennial, forming clumps that grow 4–8 feet tall each season. The long-stemmed flower spikes are produced in late summer, and should be cut for drying when fully exposed from their sheaths, but before they begin to expand on the plant. As they dry the awned spikelets of the spikes expand, as well as the silvery hairs at the base of each floret, producing a graceful fluffy head 6 inches or more long and nearly as broad.

More beautiful is *Pennisetum alopecuroides,* a relative of the lovely fountain grass. It is perennial and may grow to 4 feet tall. The flower heads are silvery, to 6 inches long, with long bristles that give them a feathery appearance. These may be cut for drying anytime after they are formed, but before they mature and begin to "shed."

For smaller bouquets, the annual grass *Lagurus ovatus* is especially suitable. Seeds planted in the spring will produce plants about 1 foot tall which bear several dense wooly heads ½–1 inches long. These heads are so shaped that this species is sometimes called the "rabbit's foot" grass.

The next two species are very attractive in their summer growth, but it is their fruit that is of beauty for winter bouquets. They are, nonetheless, included here because of their easy culture and beauty.

LUNARIA ANNUA

Honesty or the money plant is a member of the cabbage family, and like so many of that group, is best treated as a biennial or winter annual —i.e., the seeds are sown in summer, young plants stand overwinter, then flower early in the following season. The plants grow to 48 inches tall, producing several flowering stems with showy purplish (or white) flowers. After flowering, the seed pods are developed. When they reach maturity, they are round or oval in outline, about as big as a half-dollar, and very thin. In development, these pods are greenish, but at maturity, the outer layers of the pod are shed, and the seeds with them. When this begins to happen, cut the entire stalk at the base, and permit it to season indoors. After the outer layers are shed, there remains the pearl-white membrane that had divided the pod. Though fragile, these fruiting stalks are long-lasting and of great beauty.

PHYSALIS ALKEKENGI

An outstanding perennial plant that deserves much wider cultivation is the Japanese lantern. It can be grown from seeds, but may not produce many "lanterns" until the second season.

Once established, however, the rhizomes persist year after year, and each season send up numerous leafy stems 8–24 inches tall. The white flowers are not very conspicuous, being borne in the axil of each leaf, commencing near the base and continuing one by one to the tip of the stem. After flowering, the calyx develops into an inflated "lantern" around each fruit which very much resembles a miniature tomato. At maturity the "lanterns" turn bright orange-red. They will remain very attractive on the plants throughout the remainder of the growing season. For drying, however, a stem should be cut at ground level when the uppermost "lantern" has changed color. The leaves should be *cut* off, and the stems permitted to dry while lying horizontal in a place where light is reduced. If desired, mature but green "lanterns" may be dried. Chewing insects will sometimes spoil the "lanterns," but occasional spraying with an insecticide containing DDT should prevent this. Though this species can spread fast, it is easy to control, and so desirable that I have no hesitation in recommending it for any garden. It will grow satisfactorily in partial shade or full sun, and in poor or rich soil. It should be noted that seeds are an easy method of propagation, the rhizomes being somewhat difficult to transplant when in active growth, and hard to locate when dormant!

After they are dry, individual "lanterns" may be removed from the stalks, cut along the angles, and opened back to expose the red fruit within, thereby creating the aspect of a flower. Fastened to a wire stem, such "flowers" are excellent for use toward the center of a dry bouquet.

The making of the winter "dry" bouquet is just as important as the growing of the correct species for this purpose. Naturally, any bunch of flowers is just *that*—unless you arrange them. Dried flowers do need somewhat more careful arrangement than fresh ones because of the lack of foliage. Fillers such as babysbreath are, therefore, most important. It is recommended to have wire at hand when working with dried flowers to lengthen stems or to change the angle of a flower on its stalk.

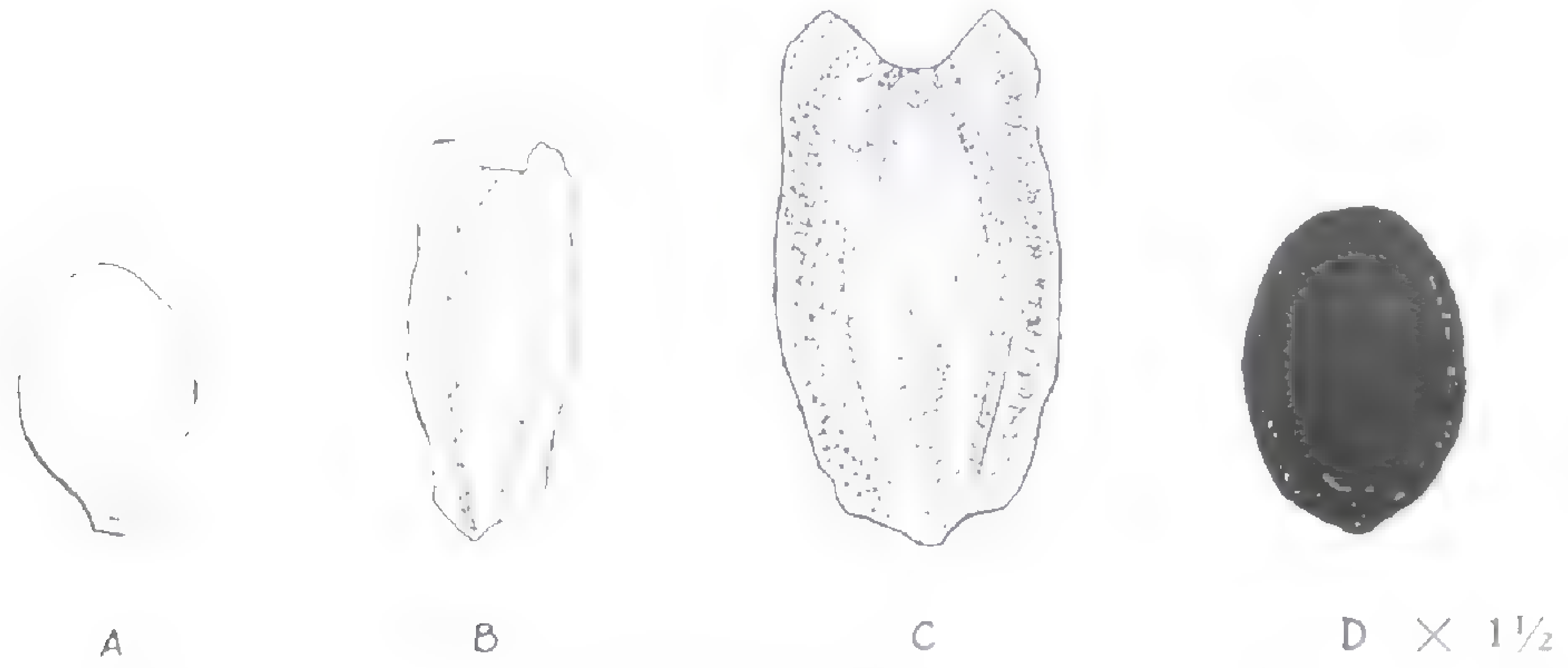
In addition to the garden flowers that can be used for winter bouquets, it is well to look about the countryside in summer and autumn for seed pods and other natural materials that can be used to add interest to your arrangements. Many of the wild grasses and sedges are excellent subjects, and the heads of wheat and rye are always lovely. Some persons collect small cattails in the early summer and dry them for use in winter arrangements, and the fruits of the lotus, bittersweet, iris, and mallow are some of the many other possible additions. In combination with appropriate container, pottery figure, or other desired inclusion, summer flowers carefully dried can be transformed into a work of beauty. Remember—it is a good idea not to use all of your flowers at once. Save some for new bouquets throughout the winter. It can be very rewarding to make a gay and colorful arrangement on a gloomy winter's day.

TRY GOURDS IN YOUR GARDEN

Gourds of many sorts are easy to grow in St. Louis and like our warm dry summers. The vines need little room if they are grown over a fence, upon a trellis, or tied to strings or wires attached to the south or west wall of a building or fence. An arbor structure is ideal for growing gourds, for they grow well in the wind and sun. They will thrive in almost any soil but seem to do best in medium-rich loose soils. Frequent applications of water to supplement the rain and small amounts of fertilizer will produce a luxuriant growth of vines and cause the plants to bear larger fruits. Too much fertilizer will produce more vines with few fruits. After June, use fertilizers low in nitrogen and high in phosphorus and potassium. Seeds should not be planted until about May 5th, when the soil is warm, and the gourds must be harvested before frosts. Two or three seeds should be planted in each hill, with about four feet between the hills. Relatively few pests bother the gourds if they are growing over a fence or anywhere there is good air circulation. Rotenone or an all-purpose vegetable garden dust which does not contain DDT can be used, if necessary. Insecticides containing DDT should never be used on gourds, squash, cucumbers or watermelons, because they seem to harm members of this plant family. Seeds of many of the gourds may be purchased from seedsmen or from the Gourd Society of America, Horticultural Hall, Boston, Massachusetts.

Easiest of all the gourds to grow in St. Louis are the small yellow-flowered kinds which are closely related to our summer and acorn squashes. These little gourds, as all other gourd members of the genus Cucurbita, are similar to the many wild gourds native to the New World.

The only cultivated plant which was widely grown in both the Old and New Worlds before the Americas were discovered is the bottle gourd or calabash *(Lagenaria siceraria)*. It probably originated in the Old World, but more



Gourd Seed

A. The seed of the small yellow-flowered gourd *(Cucurbita pepo* v. *ovifera)* are cream-color and similar to those of the acorn and summer squashes.
B. The seed of the bottle gourd *(Lagenaria siceraria)* are tan or brown and have very small "wings."
C. Seeds of many of the large bottle gourds from the old world have large corky "wings."
D. Seeds of the luffa *(Luffa cylindrica* and *Luffa acutangula)* are black, elliptical in outline and have a thin sharp margin.

than 7,000 years ago it reached the New World, probably being carried by ocean currents, from Africa to South America. This is the gourd usually referred to when the word "gourd" is used, but the term "gourd" has been applied to many of its relatives whose fruits can be kept by drying, and even some relatives of the cucumber are called gourds. Certain tropical trees bear a fruit known as "tree gourds" or "calabashes," but most of these trees belong to the same family as our catalpa tree (Bignoniaceae) and not to the family of the true gourds (Cucurbitaceae).

There are many natural sizes and shapes of bottle gourds and even more variety can be introduced by tying the very young fruits with string or wire, or enclosing them in a bottle or box. Bottle gourds were used as containers for liquids and for the storage of seeds, cloth and many other things, long before pottery was made in the Americas. The gourds still are preferred in many places for carrying liquids in the fields because they are lighter than pottery and not nearly as fragile. Dishes, beehives and birdhouses are often made from them.

Not many people know that the very young fruits of the bottle gourd can be used for food. In Brazil the young gourds are called "abobra d'agua," which means water squash, and are used as we use young summer or zucchini squash.

August Hoh is one of the most active gardeners of the Webster Groves Men's Garden Club. Each year he tries several new things in his garden and, as a result, has won many prizes in his club's competitions. Last year he planted seeds he bought under the name of "vining okra." His plants turned out to be luffa which is also called vegetable sponge or dishrag gourd. This makes a good substitute for okra and has the advantage for some dishes of being not nearly as mucilaginous. In Africa, where both okra and luffa have been grown for centuries, luffa is called "long okra." Luffa is unusual for when it is dry, it consists of a mass of fibers surrounding the many flat, black seeds. The cultivated kinds are all native of the Old World, although a weedy species found in the South American Andes may be a true native of that region. Luffa fruits can be eaten when very young, and are the major ingredients of one of the best of the many Cantonese soups. The Cantonese name sounds like "sien gwa," and I have been told that it means "many threads."

If you want to gather a succession of young fruits to eat, you should not leave any mature on the vines, because the plant produces fewer new fruits if some are left to ripen. Should you want to save ripe fruits in the fall for flower arrangements, it is best to leave one vine with the fruits maturing for this purpose. All gourds should be dried in a well-ventilated place. If the small gourds are not perfectly dry, they will soon lose their color. Waxing, after the gourds are dry, helps to deepen the color. To make sponge from your luffas, the fruit should be beaten when it is dry so that the outer skin is broken and knocked off. The gourd can then be soaked in water until soft, and trimmed with a pair of scissors. —H.C.

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MISSOURI BOTANICAL GARDEN PROGRAMS

SPECIAL Shows and Displays

African Violet Show May 7 and 8

Spring Flower Show May 14 and 15

East Central Regional Flower Show May 21 and 22, Museum Building*

Rose Show May 21 and 22, Floral Display House

Free Nature Programs for children, aged seven and over are held every Saturday morning from 10:00 A. M. to 11:30 A. M., Museum Building

Plants from Prehistoric Times May 7
Planting Your Garden May 14
Color Sound Movies May 21
Plants with Wet Feet May 28
What Is a Tree? June 4
Exploring the Underworld June 11
The Queen of Flowers June 18
Shades of the Night June 25

COURSES

See September BULLETIN for courses offered in the Fall.

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* This is a portion of the program being put on by the East Central Regional District of the Federated Garden Clubs of Missouri at the National Home May 21 and 22.

MISSOURI BOTANICAL GARDEN

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Cover: Wheat, "the staff of life," economically important member of the grass family. Photo by George V. Van Schaack.

CONTENTS

Tropical Water Lilies
The Botanist's Contribution to Timber Conservation
The Grasses
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TROPICAL WATER LILIES

GEORGE WM. PRING*

The hybridizing of tropical water lilies—as representative of the flowering seed plants—results under normal conditions in numerous, differing offspring. These resultant generations of unique plants, having varying dominant characteristics, can be of fascinating and challenging interest to the amateur grower as well as to the professional hybridist. During the past century, man, by cross-pollination, has produced countless new horticultural plants, among them, many varieties of water lilies in an astounding array of colors, physical characters, growing habits and quality. The basic technique of hybridizing the family of water lilies is simple enough to be mastered adequately by the casual grower. Without the expert's knowledge of genetics and the Mendelian Laws of heredity, the amateur grower's possibilities in cross-pollinating are limited. Experimentation by trial-and-error will be the guide of the novice whereas the professional hybridist can apply fact and theory in planning long-range crosses. The challenge is not lessened for the beginner; his opportunities simply must be more limited.

The family of tropical water lilies has three distinct methods of reproduction; the first two, budding by tubers and by viviparous leaf reproduction, are useful only in increasing the grower's stock of plants already on hand. It is the third and final method, involving sexual reproduction, that offers the professional and novice alike the opportunity to propagate totally new offspring.

The flower of *Nymphaea* is perfect, having both the stamens and pistils located in each flower. Sexual reproduction is achieved when the pollen grains from the stamens fertilize the ovules contained in the carpel, producing a zygote, which gives rise to the seed. The pistils are located in the center of the flower; they are cup-shaped and hold the scented nectar, which draws insects to pollinate the flower. The insects, upon smelling the nectar, plunge directly into the pool. As they struggle and drown, pollen grains which have adhered to their bodies sink to the base of the pistil, the receptive stigma.

The pistil is the upper portion of the carpellary structure housing the ovules, or female eggs. The carpels, averaging 28–30 per flower, are linked compartments which together form a spherical pod, the base of the female reproductive organ. When the pollen grain settles on the stigmatic surface it sends down a filament carrying the male reproductive elements. A seed is formed when this reproductive cell fertilizes the female ovule; each seed is theoretically capable of reproducing another complete plant. At the close of the fertilizing stage the carpellary sphere hardens, forming a protective pod for the maturing seeds.

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* Tropical Water Lilies by George Wm. Pring, grandson of George H. Pring, Superintendent of The Garden. Written in the course of his studies at Harvard University under a scholarship.

Encircling the pistils in concentric rows are the stamens, terete rods supporting the pollen heads. On the first day of the flower's opening, the stamens are vertical, exposing the nectar-filled pistil. On the second day the inner, shorter stamens arch over to cover the pistil, and the longer, outer stamens curve outward. On the fourth day the stamens return to a reflex position, exposing the dried pistil containing the bodies of dead insects, trapped after their role in the *Nymphaea* life cycle has been completed.

The basic problem in fertilizing the distinct plants is to bring the pollen of one to a successful contact without contamination to the ovules of the other. Because of the dominance of specific hereditary traits, it is highly important which of the selected plants is chosen to be the pollen-parent, and which the seed-parent. To bring out the greatest number of variances, reciprocal crosses, that is using each plant as the female in separate pollinations, is recommended.

A few general cautions should be observed in cross-pollination: maximum care must be taken to insure that no stray pollen grains will interfere with the planned pollen-cross; the pollination should take place on the first day of the female seed-parent's opening while the nectar cup is full; one should remember that the most highly receptive period in the *Nymphaea* life cycle is from 10:00 A. M. to 12:00 Noon, during August.

The tropical water lily growing season extends from May 15 in the Midwest or June 1 in the East to the first killing frost, usually in October. Two days before the female parent is expected to flower, the bud must be gently opened and all the stamens should be removed by hand; this step prevents the flowers own pollen from contaminating the delicate cross. No nectar must have formed in the pistil when the flower is emasculated. After all stamens have been removed, the bud is clamped tightly with rubber bands and is covered completely with gauze, a further precaution against unwanted pollen.

On the day of pollination, sufficient stamens (6–8) should be removed from the male parent; these are placed in the stigma of the female (which by now must be filled with nectar for an effective cross) and are agitated to release the pollen. Care must be taken that these pollen grains do not get mixed with other pollen; a small glass vial may be used to transport the stamens to the seed-parent. Repeating the protective process, the pollinated female must be closed, bound with rubber bands and covered with fresh gauze.

The peduncle of the plant should be attached to a stake, for after fertilization takes place, the stem bends in an S-shape and plunges the bud into the water. The stake provides the grower with a constant check on the seedpod's location. If fertilization does not take place, the flower reenters the water and will gradually decay. In three weeks, usually in early September, the fertilized pod ripens and rises to the surface to open, scattering the ripe seeds. The gauze covering, if kept firmly in place, will prevent the loss of seeds until they can be collected and stored in a jar of water. Here the individual seeds lose their gelatinous coating and sink to the bottom. When settled, they should be removed, dried for two days, planted in sandy soil and placed in a tank of water kept at 75–80° F.

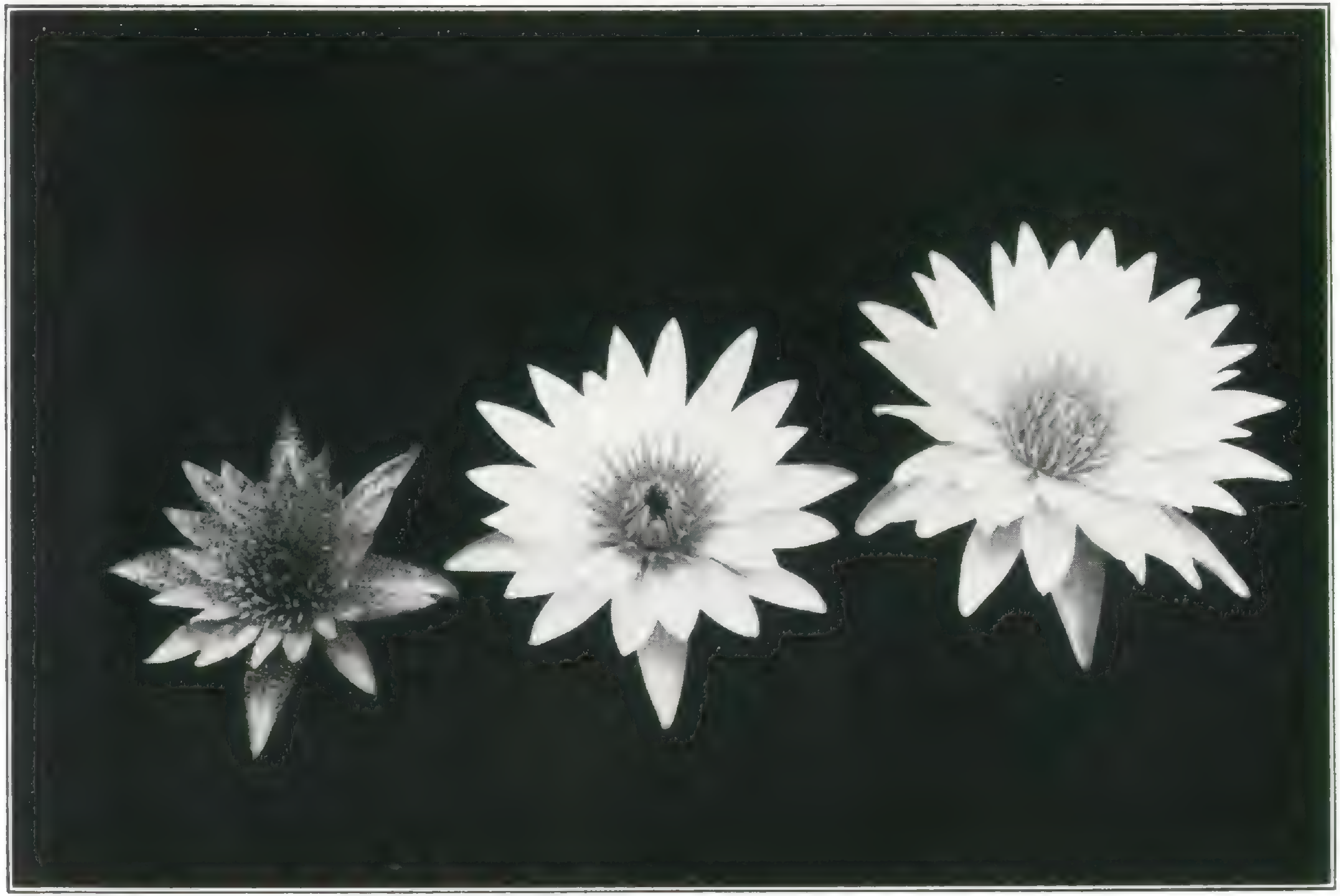
Floating leaves develop in the seedling tanks during late September and early October, provided the temperature is kept at a constant 75–80° F. The leafy plants may then be transferred to pots, where they should be nurtured in warm water until May or June of the following spring. The result of the experimental cross—the new crop of flowers produced—can be examined in July or August. One of the most rewarding features of work with the *Nymphaea* family is that the period of waiting for the hybrid to develop is comparatively short; similar work with orchids can take as long as four to six years.

Thus far, the physical methods of controlled reproduction have been dealt with specifically, while the results of this work have been relegated to a more general treatment. But it is actually the result of this process, not the process itself, which is of primary interest to the interested grower. If the grower has a favorite color in a lily produced on a plant of poor growing characteristics he could, by cross-pollination, combine the desired color with a strong growing character in another plant. It is possible that some percentage of the offspring of his chosen parents would combine the characters of good color and strong growth.

The process of producing the world's first albino tropical involved just such manipulation. The introduction of *Nymphaea ovalifolia*—a vigorous grower, having white flowers with blue tips, but few petals—gave the hybridist a logical starting point. To increase the number of petals *N. ovalifolia* was crossed with *N. castaliiflora*, a many-petaled hybrid, producing an F_1 generation with light blue flowers and a sufficient increase in the number of petals.

It was noted that some of the F_1 generation bleached white after being open several days. These plants were re-crossed with the parent *N. ovalifolia,* producing an F_2 generation with dominant white characteristics. This hybrid was carefully self-pollinated for two years to bring out the pure color, and during the summer of 1922 the world's first tropical day blooming albino—*N.* "Mrs. George H. Pring"—was successfully produced. The pink and blue traits of its parents were eliminated. George H. Pring, superintendent of the Missouri Botanical Garden, produced this hybrid, which was named for Mrs. Pring.

The little-known species *N. Burttii*, a natural small flower of primrose-yellow color, stimulated a search in 1930 for a full yellow hybrid. Before



Nymphaea burtii, the pollen parent, *N.* "Mrs. George H. Pring," the seed parent, and *N.* "St. Louis," the offspring.

× NYMPHAEA "AVIATOR PRING" (BRACHYCERAS), PRING

N. capensis zanzibariensis f. *rosea* ♀ *N. capensis zanzibariensis* f. *rosea* ♂

N. capensis zanzibariensis cv. castaliiflora ♂ *N. ovalifolia* ♀

N. ovalifolia ♀ *N.* "Mrs. Edwards Whitaker"

N. "Mrs. George H. Pring" ♀ *N. Burttii* ♂

N. sulfurea ♀ *N.* "St. Louis" ♂

N. "Aviator Pring"

the introduction of the African yellow into the U. S. through the efforts of George H. Pring it was thought impossible for the genes of the tropical water lily to form the yellow pigment. When *N. Burttii* was pollinated with the original white species (*N.* "Mrs. George H. Pring"), the offspring showed dominant yellow characteristics. Other colors detected—blue, white and pink—were traceable to the parentage of *N. Burttii* and that of the albino, but were recessive. By cautious, planned crossing between the original white and the yellow the first commercially-practical yellow hybrid was produced, *N.* "Aviator Pring." The plant was named by George H. Pring for a son who died in World War II. (The enclosed diagram of two hybrids illustrates their relation and derivation.)

An expert will seldom encourage seed reproduction for an amateur seeking only to increase his stock of lilies, for commercially produced hybrids are available in widely varied colors and sizes and at a reasonable cost. Needless to say, stocking one's pond with commercial hybrids is less difficult than developing one's own species, by trial and error.* But for the water lily fancier who desires to experiment with heredity in bringing out certain desirable traits in his plants, hybrid-

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*One instance of the odds against the hybridist is the fact that of the 246 pollinations using the yellow hybrid of *N. Burttii* as a parent only eight acceptable new hybrids were produced. See the MISSOURI BOTANICAL GARDEN BULLETIN, XXII, (February, 1934), p. 50.

ization is a useful and fascinating process. Time and increased study of genetics will enable the grower to look beyond one succeeding generation, giving him a larger field of operation: like the once "impossible" objective of producing the first albino hybrid from colored tropicals.

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THE BOTANIST'S CONTRIBUTION TO TIMBER CONSERVATION

TRIFON von SCHRENK

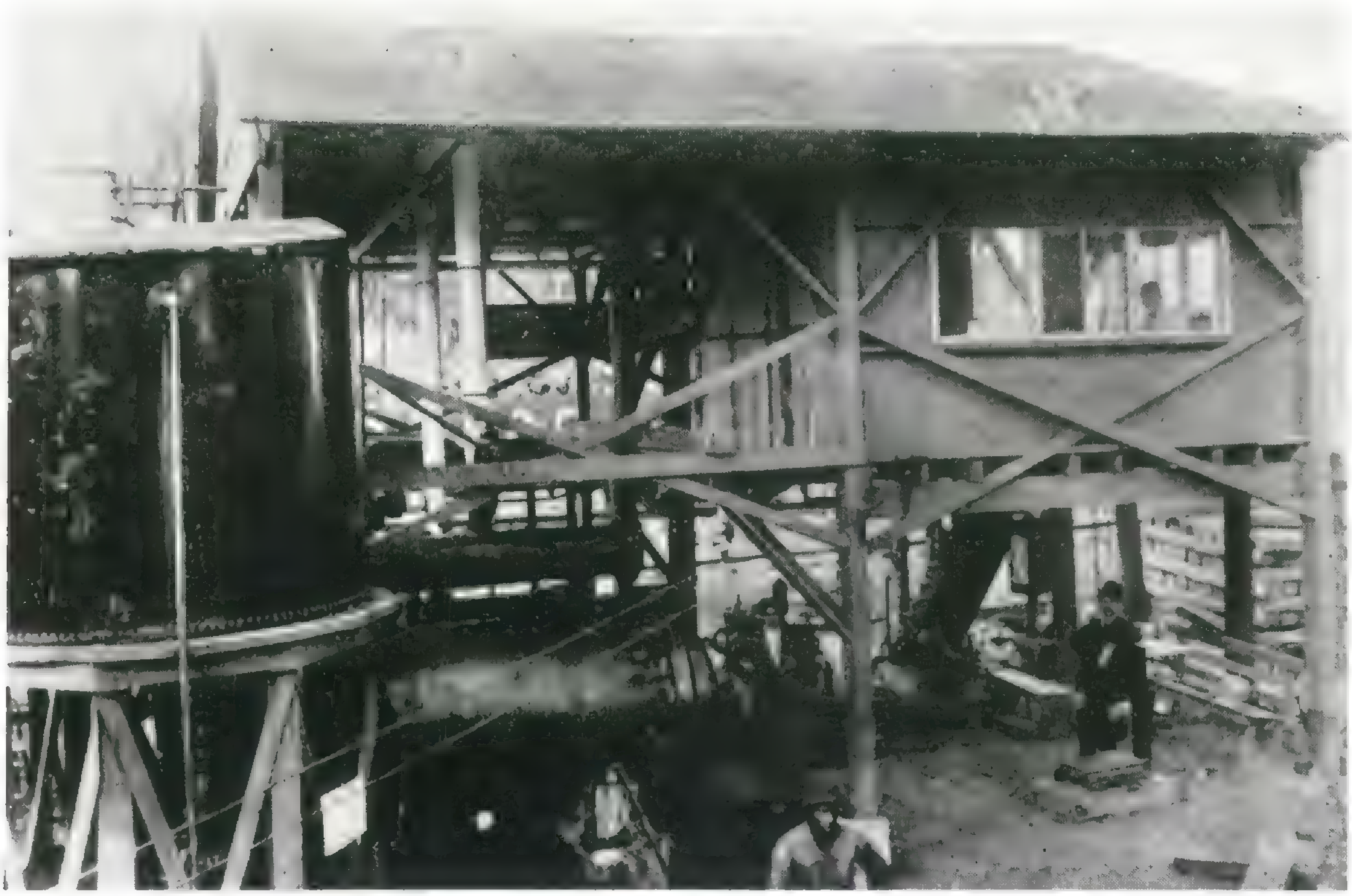
The term "Conservation" as it is commonly employed, usually refers to such matters as keeping our national resources from becoming depleted, either by setting aside certain areas or by restricting the use of various natural products or by employment of improved methods of control. Such conservation measures are among the direct approaches toward saving our national assets. The indirect approaches toward the same objective are not always so obvious and it is probable that the general public is not fully aware of what has been done in the past fifty years and what is still being accomplished along lines that are perhaps not spectacular but nevertheless of great significance. A synonym for conservation is "preservation." Any effort to preserve one of our resources, that is, make it do service over a greater period of time than would otherwise be the case, is a contribution to conservation.

From earliest times, man has tried to preserve timber from the ravages of decay and insect attack. For many centuries the motive for making wood last longer did not involve any consideration of saving trees. The objective was rather to postpone the date on which a structure would have to be rebuilt. The question of transportation of wood to the building site was also a factor. It was not until it became apparent that timber was getting scarcer or more remote, that real efforts were made to give more lasting protection to wooden structures. Pitch and bitumen had of course been in use for sealing and waterproofing since earliest times and it is conceivable that the early experimenters were influenced by Biblical, Egyptian and other ancient accounts. Such coatings, cements of various kinds and paints and varnishes came to be used. These surface applications did much to prolong the useful life of wood, and to this day, the development of surface protectives continues to form the basis of a large industry.

The cause of decay in wood was never clearly understood until the problem was investigated by the botanists. Long continued studies by mycologists and plant pathologists, to which scientists at Missouri Botanical Garden made noteworthy contributions, finally established the fact that so-called wood rot was due to saprophytic and sometimes to parasitic organisms or fungi which use the wood as food, thereby breaking down its structure and causing it to collapse under load. It is not the purpose of this article to deal with the intricate physical and chemical processes involved in the destruction of wood by fungi and by animal forms. It is sufficient to note here that the recognition of the causes for wood deterioration led men to think of ways and means to counteract them. If a means could be found to make a bridge timber resist decay for twenty to thirty or more years, a threefold gain was in prospect, namely—a saving in repair and replacement costs, a safer structure, and last but not least, conservation of the available timber growing in the forests.

The diminishing supply of timber was felt in England and on the Continent long before we in the United States had any such experience. As a result, the Europeans applied themselves to the question of timber preservation long before we did. During the latter half of the last century the question of labor costs in those countries was nominal when compared to the high cost of their materials, and this is to some extent still the case. The growing scarcity of timber encouraged extensive reforestation on the one hand and on the other hand gave impetus to increasing efforts to find some chemical or chemical compounds that would successfully check the work of the wood-destroying agents. It was found eventually that treatment with solutions of some of the chemical salts and of "tar oil" and of creosote, went a long way towards extending the useful life of a piece of wood. Volumes would be required to describe the details of all the tests that were made with various compounds, including the use of common salt to preserve coal mine props in Bohemia and trials with sugar solutions in India. We are indeed indebted to those early pioneers in Europe and elsewhere for much of the basic knowledge on which our later research has been built.

Two important aspects were realized as men gained in experience. First—the material added to the wood had to be sufficiently toxic to inhibit the growth of fungi or kill the fungi; second—a surface painting was of short protective value for wood that was continuously exposed out-of-doors. Paints did very well for the sides of houses. Repainting such structures every few years was not too much of a problem, but bridge timbers, railroad ties, piles, telephone and telegraph poles and fence posts, constituted a class of wood products that were exposed to unusually severe conditions. Most of them were in contact with the soil and when they failed it was expensive to



1904 St. Louis World's Fair Experimental Timber Treating Plant

PHOTO BY H. VON SCHRENK

Ties being introduced into treating cylinder at a modern timber treating plant.

PHOTO BY F.L.E.

replace them. It was found that decay was greatest at or just below the ground line where conditions of temperature and moisture were most favorable for the growth of wood destroying organisms. Painting would not give enough protection here. The best answer was found in pressure treatment, by which is meant a process of injecting a toxic solution into the wood to the greatest effective depth and in predetermined amounts.

Briefly, pressure treatment of timber involves removal of bark, seasoning, either by air drying or by various other means, and enclosing the wood in sealed horizontal cylinders where it is exposed to the heated treating solution under pressure. At some stages a partial vacuum is created in the cylinder. When a sufficient number of hours have elapsed, the pressure is released and the treated wood is withdrawn, either with or without a final vacuum treatment. Throughout these operations, careful watch is kept over the temperatures, pressures, vacuums and quantities of preservative injected. Specific variation and sequences of these factors form the bases for a number of patented processes.

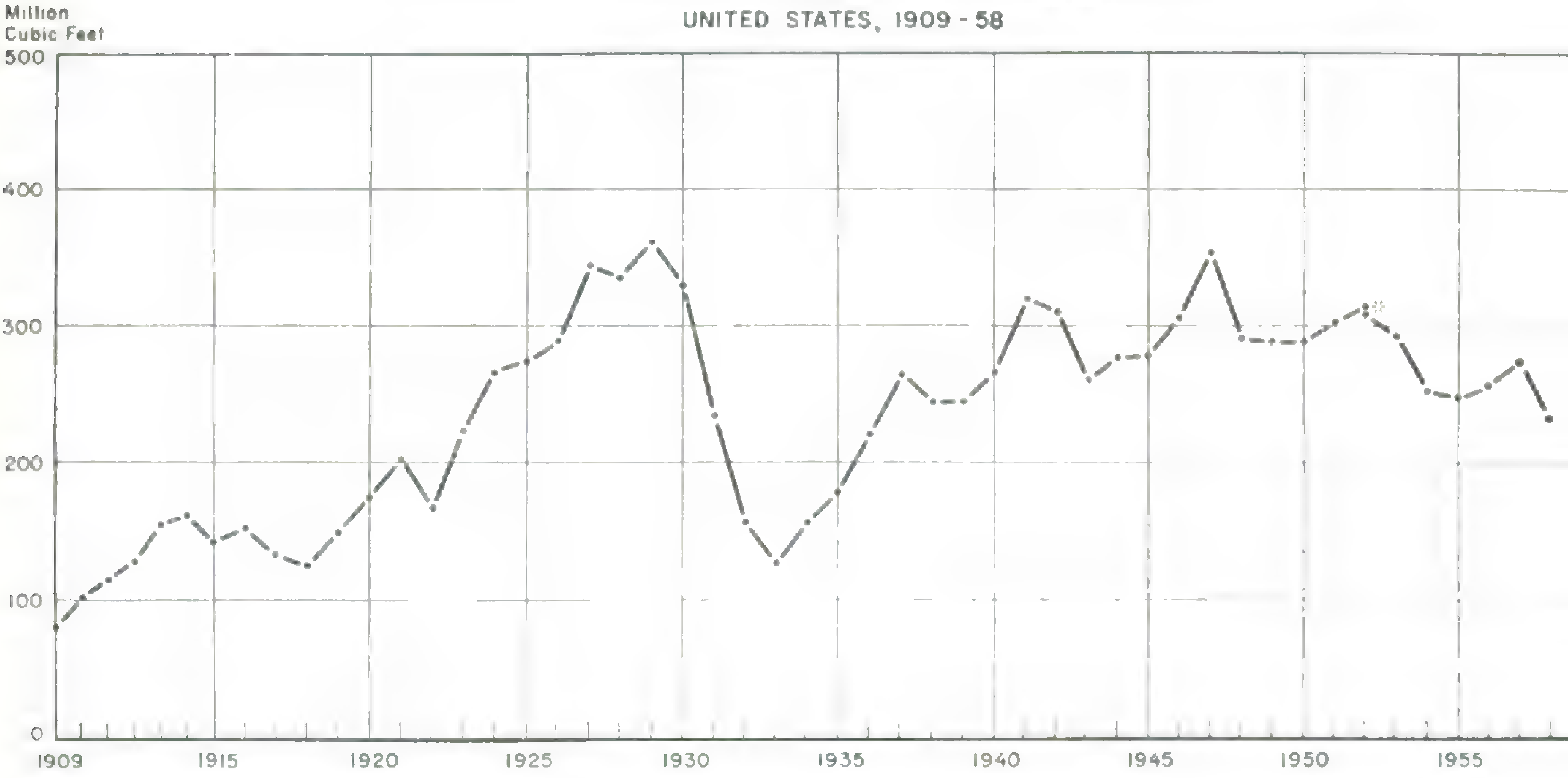
Creosote derived from coal tar was for many years the principal product relied upon in pressure treatment. It is a by-product resulting from the destructive distillation of bituminous coal during the coke making process at steel mills, and should not be confused with wood-creosote which is derived from the distillation of wood. Later it was found that for some purposes, equally acceptable results could be obtained by mixing creosote with coal tar in various proportions, at important savings in material costs. Concurrently, progress was made with water soluble salts and these are also used today in considerable quantities. In these, important roles are played by zinc, copper, chromium, arsenic, fluorine, chlorine, ammonium, phosphorous, dinitrophenol, boron and other chemicals. Pentachlorophenol dissolved in petroleum has proven to be an excellent preservative also and its use is likewise on the increase. Light and heavy petroleums are in use as solvents and extenders and other properties are being studied.

It should be borne in mind that creosote treatment, directed primarily to prevent fungus attack, is also effective in proper retentions, in protecting wood against termites and marine organisms, known colloquially as ship worms. Powder-post beetles and carpenter ants are also among the wood destroyers that are warded off. Treatment of wood to make it resistant to fire should be mentioned here since efforts along that line are likewise of great economic importance, and, from the conservationist's point of view, constitute another of the indirect approaches mentioned previously.

In order to bring into focus what significance should be attached to timber treatment when we speak of conservation, the following table is abstracted from Vol. 55 of the Proceedings of the American Wood Preservers' Association. It shows the amounts of timber treated per year in the five year period, 1954 to 1958 inclusive. These figures are represented graphically on the chart which follows, taken from the same source. It will be noted that the figures are given in cubic feet of wood treated. Multiplying by 12 gives the equivalents in board feet measure. If this is done for the year 1957, we find that 274,-500,000 cu. ft., or over 3¼ billion board feet of wood were treated during that year. All of this wood will serve from 15 to 35 years and a large proportion will probably last much longer. As we know, wood in these categories, in the untreated state, would last a mere fraction of that time. The figures indicate the length of time made available to us through chemical treatment, in which we may grow new trees of equivalent use value. We are also led to think of how the value of our investment in this treated wood at 1957 prices will continue to increase over the years to come, commensurate with the upward trend of the labor and materials costs curves. That the importance of timber treatment has received ever growing recognition, is shown on the chart by the rise of the curve from 1909 to 1929 and by a similar rise starting in 1934 after recovery from the 1929 depression period. Year to year minor fluctuations are largely due to economic conditions of one kind or another. The recent downward trend of the curve may be attributed largely to the reduced spending forced upon our railroads, a subject on which a large volume could be written. The drop may also be interpreted in part as reflecting the cumulative effect of treatment over the years. The implications as to conservation are obvious. In 1958 we had 369 timber treating plants, including both pressure and non-pressure plants, most of them commercially owned, serving various

FOREST PRODUCTS TREATED WITH PRESERVATIVES

UNITED STATES, 1909 - 58



⁂ For 1952 and previous years total volume treated was based on a constant average volume per unit for each class of material Subsequent data are based on currently reported cubic foot volumes

From Proceedings of American Wood Preservers' Association Vol. 55, 1959, page 258

MATERIALS TREATED IN THE UNITED STATES 1954–1958 IN CUBIC FEET INCLUDING ALL PRESERVATIVES

Year	*Crossties*	*Switch Ties*	*Piles*	*Poles*	*Wood Blocks*
1954	105,529,303	7,422,255	12,317,768	63,873,288	2,768,472
1955	85,918,977	7,256,684	13,934,824	74,765,763	2,817,302
1956	83,226,387	8,068,118	16,845,129	85,805,108	1,807,244
1957	101,529,365	8,065,851	16,269,644	84,021,451	1,598,823
1958	73,934,502	6,667,996	16,188,133	73,813,322	(1)

Year	*Crossarms*	*Lumber and Timbers*	*Fence Posts*	*All Others*	*Total*
1954	3,743,192	37,006,274	15,231,700	2,770,445	250,662,697
1955	4,330,044	39,433,212	16,226,742	3,761,227	248,444,775
1956	4,686,087	41,030,788	12,770,058	3,612,412	257,851,331
1957	4,601,566	41,874,651	13,384,478	3,155,620	274,501,449
1958	3,367,362	39,105,229	14,890,212	4,811,663	232,778,419

(1) Included in "All Other" in 1958.
Abstracted from Proceedings of American Wood Preservers' Association Vol. 55, 1959, page 270.

industries, the balance being railroad owned. Many of the treating companies have been practicing scientific forestry on their own large timber tracts—an additional noteworthy contribution to conservation.

Studies of chemicals and methods of evaluating the results of treatment are being pursued continuously by Government agencies, by private corporations and individuals and by large organizations such as the American Society for Testing Materials, the American Railway Engineering Association and the American Wood Preservers' Association. The work at Missouri Botanical Garden in the early 1900's was largely responsible for the formation of the last named group, an organization of men who have fostered the underlying principles discussed above. Studies in plant pathology at institutions of learning continue to advance our knowledge of cause and effect. An enormous amount of work is being done by committees of associations such as those named above and by individuals and corporations, on a great many problems other than the decay factors, that have a bearing on the durability of wood in use. This necessarily brief mention does not do justice to the scope and importance of those endeavors. They all contribute to the over-all effort to use our available wood in the wisest ways possible.

This story has of course been recounted frequently in technical publications and is a familiar one to the timber treater. It is presented here to the readers of the BULLETIN because it illustrates the far reaching effects on our economy that may result from purely academic studies in the natural sciences.

It may on first consideration appear paradoxical that a man whose self interest is served by cutting down trees may be found in the front rank of conservationists who are doing everything possible to prevent the destruction of our trees. It is hoped that what has been said above may serve to make clear how this seeming contradiction may be resolved by showing how the fundamental work of the botanists and other biologists has enabled the consumer to arrive at long-range appraisals of wood consumption and wood replacement. To maintain the balance, wood conservation through wood preservation has given us a large part of the answer. While certain exceptionally resistant or useful species, such as tidewater red cypress, long leaf yellow pine and northern white pine, are now the subjects of nostalgic conversations about the good old times, we may nevertheless look into the future feeling assured that we will continue to have all the wood we will need as long as we continue on the alert in the cooperative work between scientist, processer and consumer, as herein sketched.

THE GRASSES

THE grass has been growing again for several weeks, and anyone who confesses to know something about grasses has heard more than once, "You're just the person to tell me what to do about my lawn." As well he should have heard, "You're just the person to tell me what to do about my cottage cheese," or beer, or bamboo fishing pole, or sugar, or sirloin steak, or bourbon highball, or bread and so on and on.

Stand at the checkout counter of a supermarket someday and watch the grasses as they pass. Essentially all the meat (from forage-matured and grain-fattened cattle, corn- and milk-fed pigs), all the dairy products, all the poultry products, all the bread and cereals, most of the sugar, are directly the product of grass. Certainly in the temperate zone and cooler tropics seventy-five percent of all human energy is obtained by eating grass directly as bread, cereal or sugar, or indirectly in meat, dairy products, and the like. In our own plush civilization we mix our grass with large amounts of the vitamin foods, fruit, fresh vegetables and so on. But this is not a universal practice. In parts of India, for example, the poorer people eat the same meal three times a day, a gray porridge, boiled up from the tiny seeds of a relative of the goosefoot grass, which grows as a weed in our sidewalks, about as appetizing as last night's dishwater, although lots more nourishing. In eastern Asia and Indonesia, the grass may be more palatable, rice, three times a day, if you're well-off, or the cheaper millet if you're not, and not too much besides.

Most of the world's alcoholic drinks are derived from grass. Beer from barley (John Barleycorn) and other grains, whiskey chiefly from corn (bourbon), rye (rye) or barley (scotch), sake from rice, chicha (in the Andes) from corn. Industrial ethyl alcohol is made almost entirely from grass, whence its common name, grain alcohol.

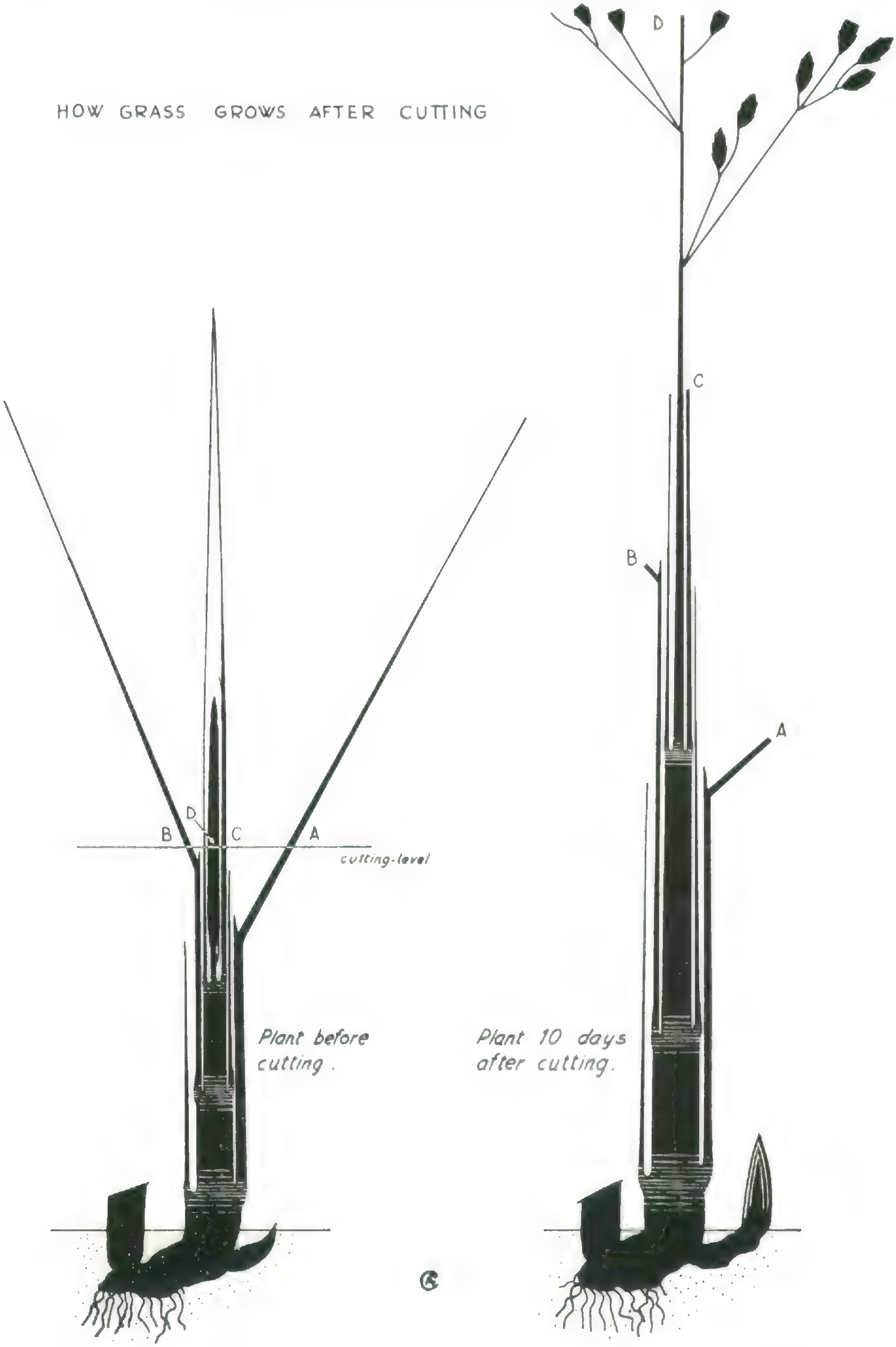
Here and there over the earth there are small, or even larger groups of people who live without depending on grass. The Eskimos of the north live on fish, many central Africans subsist on palms, river Indians in South America on cassava, and there are others. But these groups are all relatively small compared to the concentrated populations of industrial Europe, Asia and America and the untold millions of Chinese and Indonesians. India is a somewhat conspicuous exception. Here, it is true, much rice, millet, sorghum and corocana (goosefoot) are eaten, but probably more important are the fruits of many other plants with small seeds and those of a great variety of legumes. Not only does grass sustain all industrial civilizations today, but scarcely any important civilization developed far until grass became its staple. In China it was rice, in India millet and sorghum, in the Tigris-Euphrates and Egypt wheat; in Greece and Rome wheat again, and other grains; further north in Europe rye and barley; in Mexico and Peru it was maize, or Indian corn.

What is it about grass that has granted it this ascendancy? It is several things, of which perhaps the three most important are: Its phenomenal yield, the way it branches at the base, and its growth-habit above ground. From one grain of wheat a plant producing five hundred or more grains can be grown; a kernel of corn may grow into a plant producing three or four thousand grains. Some wild grasses will produce from a single seed up to twenty-five thousand seeds in the first season! These yields are beyond anything found in any other generally adaptable group of plants with useful fruit, both palatable and wide-ranging in variety.

Some grasses, notably several of the cereals such as corn and wheat, branch repeatedly at the base. This habit, known as 'tillering,' enables a single seed to produce very quickly a plant with many almost equal shoots, all growing at the same rate and ready to yield about equally. Beans, tomatoes and many other vegetables branch, it it true, but *above* the base, the branches being dependent on the main stem in a way that the tillers of a grass are not. Some authorities have considered tillering, which among cultivated plants is restricted to grasses, to be more important to the dominance of grass than all other characters peculiar to this group combined. Other grasses branch at the base to form underground stems, or rhizomes, thus spreading out to form turf. Bluegrass is a typical example, and it is this turf-forming tendency which makes it so desirable as a lawn grass, and, more importantly, as a field and forage grass.

Finally, grasses grow *from down below* instead of *up on top*. Cut off the top of a young cabbage plant and you lose your cabbage. Cut off the top of a young wheat plant and you lose essentially nothing. The plant is growing at the *bases* of the leaves and the treasure of the wheathead is still forming way down inside, protected by many layers of leaves. It is this

HOW GRASS GROWS AFTER CUTTING


D
B
C
A
cutting-level
Plant before cutting.
D
C
B
A
Plant 10 days after cutting.

DRAWING BY COCUCCI

'way of life' which makes grass so great a forage plant—as it is chewed off from the top it grows up from below, in fact, up to a point some grasses seem to be stimulated to extra vigorous growth by being cropped.

So this year don't cut *all* your lawn down to one and a half or two inches. Do a little experimenting in cutting-heights on the back lawn and take note of how the plants behave. Especially, save at least a small plot where you don't cut at all, but just watch what happens. If you look sensitively and reflectively you won't be disappointed.

—G.B.V S.

A GARDEN CONTRIBUTION TO SECONDARY-SCHOOL EDUCATION IN THE ST. LOUIS AREA

WHEN the Congress of the United States established the National Science Foundation in 1950 with an initial budget of $3.5 million, programs were initiated which last year were successful enough to warrant a budget of 155 million. The justifying steps leading up to this latter figure cannot be retraced, in the opinion of the Chairman of the National Science Board, Mr. D. W. Bronk. There of course have been fears of dictation of science from Washington, but they have not been realized. Rather than stifling private efforts in the field of science support, this federal money has actually stimulated such sources to provide more and more money for research and education. All these monies mean a greater opportunity than ever for scientists.

From where will they come? There is an alarming dearth of trained teachers, and no prospect that the requisite number will be forthcoming, according to Dr. Alan T. Waterman, Director of the National Science Foundation. He continues his 1959 Annual Report by noting that the teaching of basic aspects of science and engineering must be stressed. He even comments that quite possibly such teaching may be a more important activity than furthering research by already qualified individuals. Congress has earmarked considerable sums specifically for improvement of the level of high-school instruction.

One of the many teacher-training programs administered by the National Science Foundation is that of the In-Service Institutes. These sessions provide high-school teachers with a sort of "on-the-job training," in that they are for specific subjects in the sciences. Participants receive no stipends, but are given small travel allowances. This procedure favors the premise that only dedicated teachers interested in learning will apply. During the 1959-60 school year, about 9000 secondary school teachers had an opportunity for further study under this program. There were 320 Institutes of this type held throughout the country. The Garden was chosen by the Foundation to be one of this number.

Our Institute was for one college semester in Botanical subjects. Each Wednesday night in the small room of the Museum, twenty biology teachers spent from 7:30 until 10 tearing plants apart and discussing knowledge gained, teaching methods used and ways to introduce some of these exercises into their own classroom curricula. One session was a Saturday trip around the Garden to study possibilities open for class excursions. Six sessions were devoted to topics of plant structure, seeds and their germination, twig identification and plant cell division. Four sessions covered topics in environmental control of plant growth, the physiology of growth control, respiration and photosynthesis. One meeting considered the greenhouse plant collections and their utilization in classroom study; another went into details of construction and management of an inexpensive "basement greenhouse." This latter topic proved so popular that we are about to undertake a separate and greatly expanded program to make this knowledge available to high schools throughout the country. Two sessions were devoted to the study of coal-age plants, complete with take-home specimens of 250-million-year-old plants.

We were visited in early December by Mr. Albert Young, a member of the Science Foundation staff, who was profoundly impressed with the enthusiasm displayed by our group. But after all, they were receiving first-hand give-and-take instruction from such people as Henry Andrews, Frits Went and Edgar Anderson, all world leaders in their fields and excellent teachers as well. Each of these men is vitally interested not only in his own work but also in the problems of teaching. How could there help but be enthusiasm?

At the close of the Institute, we asked for letters of evaluation from the participants. These letters not only made heart-warming comments on our efforts; they added valuable constructive criticisms as well. Selected portions of their comments were included in our report to Washington, where they will help decide National Science Foundation policies in the coming years.

Encouraged by our apparent success, we enlisted the aid of members of the Department of Zoology by Washington University, and submitted a proposal for an In-Service Institute in Biology for the full academic year 1960-61. Notification has just been received of its acceptance by the Foundation. The Garden thus looks forward to serving a new group of 25 high-school biology teachers in our area. —N.H.N.

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Kenneth A. Smith	Engineer
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Robert E. Woodson, Jr.	Curator of Herbarium

SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical Garden (the official name chosen by Mr. Shaw) carries on the garden established by Henry Shaw over a century ago at Tower Grove, his country home. It is a private institution and has no support from city or state. The old stone walls and cast-iron fences, the Linnaean House, the Museum, the Mausoleum, and the Tower Grove mansion all date from Mr. Shaw's time. Since his death, as directed in his will, the Garden has been in the hands of a Board of Trustees who appoint the Director.

The Garden is open every day in the year (except New Year's and Christmas) from nine A. M. until seven P. M. spring to fall and until six in the winter time though the greenhouses close at five. Tower Grove, itself, Mr. Shaw's old country home, is open from one until four, admission fifty cents, with special guides. The Garden is nearly a mile long and has several entrances. The Main Entrance, the one most used by the general public, is at Tower Grove and Flora Place on the Sarah bus line (No. 42). The Park Southhampton buses (No. 80), direct from downtown, pass within three blocks of this entrance and stop directly across the street from the Administration Building at 2315 Tower Grove Avenue. The latter is the best entrance for students, visiting scientists, etc. It is open to such visitors after 8:30 A. M., but is closed on Saturdays, Sundays, and holidays. The Cleveland Avenue gate, 2221 Tower Grove, is nearly always open, and there is a service entrance on Alfred Avenue, one block south of Shaw Avenue.

Since Mr. Shaw's time an Arboretum has been developed at Gray Summit, Mo., State Highway 100 adjacent to Interstate Highway 44. It is open every day in the year and has auto roads as well as foot trails through the wild-flower reservation. There is a pinetum and an extensive display of daffodils and other narcissi which are at their best in April.

MISSOURI BOTANICAL GARDEN

Bulletin

September 1960
Volume XLVIII
Number 7

LAWN ESTABLISHMENT AND CARE

Cover: Garden knolls looking south and east. Showing the effects of high mowing, up to five inches, with regular feeding and weed control. Photo by ELE

CONTENTS

Lawn Establishment and Care
Text photos and illustrations from the Lawn Institute.

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Vol. XLVIII No. 7 SEPTEMBER 1960

LAWN ESTABLISHMENT AND CARE

ROBERT W. SCHERY

Nearly a decade ago an article on "Lawn Establishment and Care" for this midcontinental area appeared in the Bulletin for the first time. How striking the new developments since then. No, the difficult climate has not changed—it is still neither wholly northern nor southern when it comes to lawn selection; the old favorites of lawn seed mixtures, Kentucky bluegrass and varieties of red fescue are still the same, and are still among the best grasses for lawns managed to favor these species; the sophistication of homeowners and availability of information has improved, leading to wider recognition of lawn possibilities; but especially has the introduction of new equipment and products made obsolete many cumbersome procedures of only a decade ago.

Modern merchandising has placed at the disposal of almost every homeowner convenience items, a rarity a few years back. Rotary mowers with easy height adjustment now make it feasible to mow bluegrass and fescue high during the summer, as they should be. This in itself goes far to assure that such a coveted lawn can be held in spite of hot summers. Effective crabgrass controls have appeared, plus mechanical devices for their quick, uniform application. A revolution has occurred in lawn fertilizers, or at least a revolution in our thinking of how they should be used.

All of this does not mean that lawn making and care is easy in a climate having muggy summers, so difficult for northern grasses, and relatively protracted winters, which spell the doom of attractive and glamorous southern lawn grasses.

Choice of Lawn

There are several options for mid-latitude lawns. In addition to the favorite bluegrass-fescue turf, hardy varieties of southern lawn species are now available. The newer flare for outdoor living and intensive use makes even limited annual replanting worthwhile, which today is less of a burden because of labor-saving equipment. So, first of all, must come a preference decision between three alternatives. First, is a southern-style lawn of bermuda or zoysia wanted? This is luxurious in summer, but bleak and straw-colored from October until the next April. Secondly, do you want the familiar northern type? This is

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Lawn Establishment and Care by Robert W. Schery, Ph.D., Director of the Lawn Institute and nationally known turf authority. He received his Ph.D. from Henry Shaw School of Botany in 1942.

attractive in autumn, most of the winter, and through spring, but going off color or needing special attention half of the summers. Or lastly, will it be a lawn of convenience, abandoned in summer to crabgrass and weeds and seeded with bermuda grass, which is not expected to survive winter, then reseeded with rye grass each autumn for winter greenness. This latter option imitates the "winter grass–summer grass" cycle of the South, which alternates bermuda in summer with expendable ryegrass or bluegrass–fescue for cooler months. The change-over period in autumn and spring is unattractive and bothersome.

Not only is there this choice in the basic type of lawn, but habitual care and usage should also be considered. We will presume that lawns discussed here are "out front," not hidden play areas or athletic fields (which may merit use of some of the coarse hay-grasses, such as Kentucky 31 and tall fescue). Lawn success with the better grasses is less a question of expense than it is of recognizing that different species show differing responses to such matters as preferred cutting height, appropriate season for fertilization, thinning of matting types, diseases peculiar to the species, and the like.

Southern-style lawns are appealing for areas concerned only with summer use; yet the long dormant season, winter weed control needs, and the intensive care required in summer, limit the practicability of such lawns. In general I favor seedings of bluegrass–red fescue mixtures for the mid-continent, even if more exacting care may be needed than farther north. This BULLETIN will therefore emphasize the northern-type lawn, based upon Kentucky bluegrass and red fescue varieties (Chewings, Illahee, Pennlawn, Rainier, etc.). If bentgrass is to be used, it should be treated as a specialty grass and accorded the especial attention of professional care.

BASIC REQUIREMENTS

Lawn Keeping, Southern Style. Southern grasses, that is, bermuda and zoysia grow only during warmer periods. Assuming that soil fertility and moisture are adequate, they are quite active even in the heat of summer, when bluegrass wisely goes semi-dormant.

Bermuda is such a fast and prolific grower, mowing may be necessary twice a week all through the summer. This heavy feeder needs ample fertilization to maintain good color, a monthly application, ordinarily. Clippings should be collected to lessen build-up of a smothering layer, but even then the tangled mat of stems may need thinning from time to time.

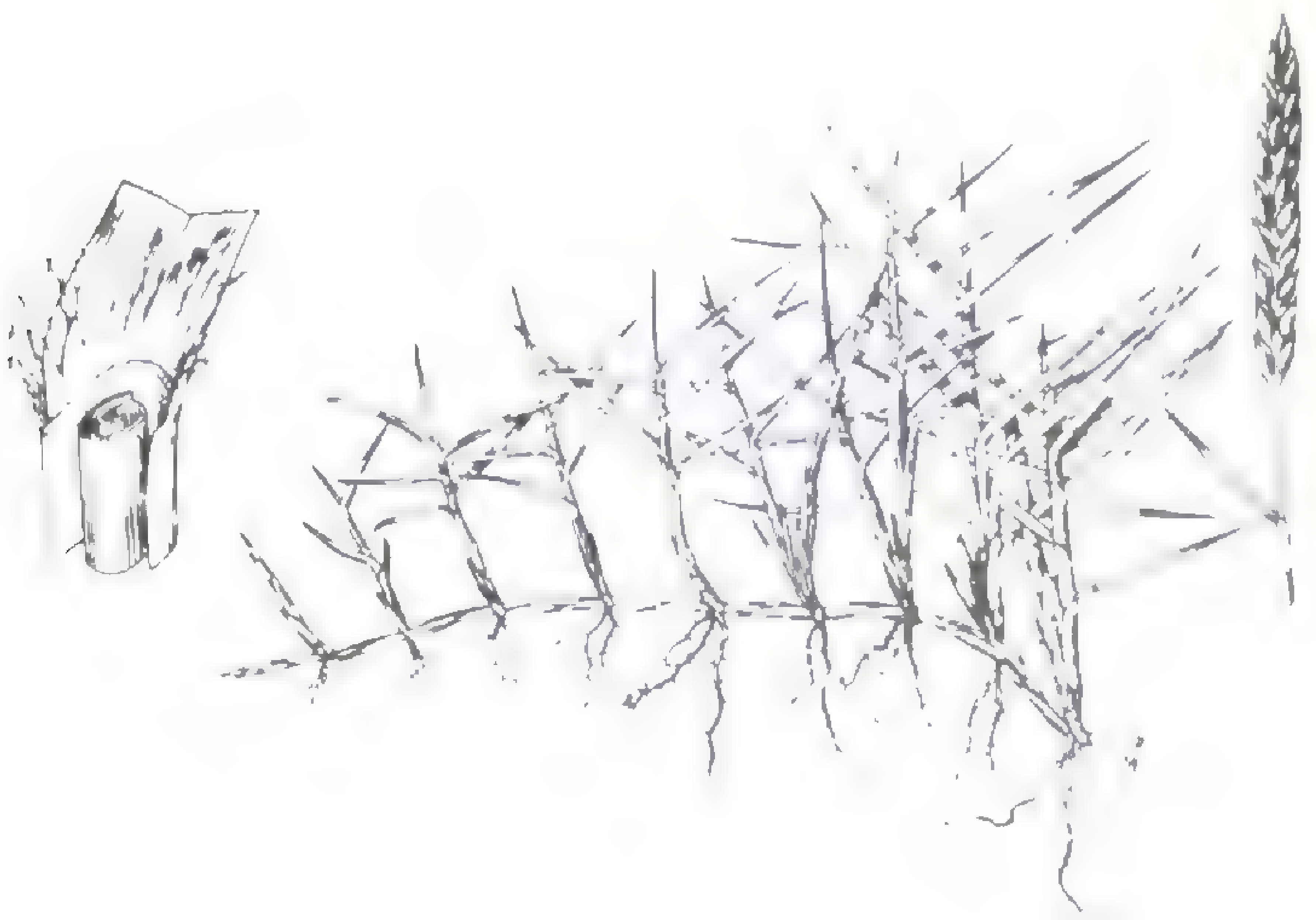
Bermuda straw is not stable when the plant is dormant. The dead stems crumble so that the lawn in winter is not good footing. Usually winter weeds such as chickweed, henbit and cresses spring up, making the natural unattractiveness of off-season color even worse. Yet the hardy bermudas are so thick in autumn that it becomes difficult to seed a temporary winter grass into them as is customary under the two-grass system in the South. Autumn overseeding is more for loose, seeded bermuda than for the improved vegetative varieties. U-3 is the most frequently used, although Sunturf, Tifgreen, Tiffine and others have proven hardy most winters.

Zoysias are not quite so troublesome since they are slow growers. They make a resistant turf underfoot, even in winter, the straw not crumbling as does bermuda. The hardy varieties, Meyer zoysia especially, are the usual planting. They make a tight sod such that winter-grass inter-seeding is not practicable. The zoysia can be thinned, if necessary, by burning in late winter to reduce mat accumulating, but this presents a period of unsightliness.

The biggest drawback to zoysia in mid-latitude climates is its very slow establishment. Even under the best of care a tight sod is seldom obtainable in less than three summers. Regular fertilization and weed control during the interim are necessary. Do not be misled by "miracle" claims for zoysia; it is not that good, even in the deep south. Furthermore, as with the named varieties of bermuda, Meyer zoysia must be hand planted from sprigs or plugs. varieties do not come true from seed.

Lawn Keeping, Northern Style. Kentucky bluegrass–red fescue mixed turf consists of grasses which thrive best in the cooler seasons. A northern lawn seed blend of quality will contain at least 80% of these proven perennials, and little or no so-called temporary nursegrass. Unlike bermuda and zoysia varieties, bluegrasses and fescues are everywhere available as seed. Natural Kentucky bluegrass is harvested from "wild" stands in Kentucky, Missouri and northward, and has much to recommend it as the basic bluegrass component for this area. Quality red fescues mostly come from Oregon.

Autumn, preferably September, seeding is to be preferred. Spring seeding may get by in light shade, or when



Zoysia matrella

summer heat and weeds are not too severe. Fertilization should receive emphasis in the autumn and be minimized as spring progresses. Many lawns in the area fail because bluegrass and fescue are forced to "soft" growth with too much nitrogen during the heat of summer.

Summer is the season of lawn travail. Weeds are always a threat, crabgrass especially. High mowing helps to keep sod thick enough to shade out much crabgrass. The remainder, at least in the drier years, can be controlled rather effectively with chemicals. The pros and cons of watering will be discussed later, but, in general, watering causes as many problems as it cures.

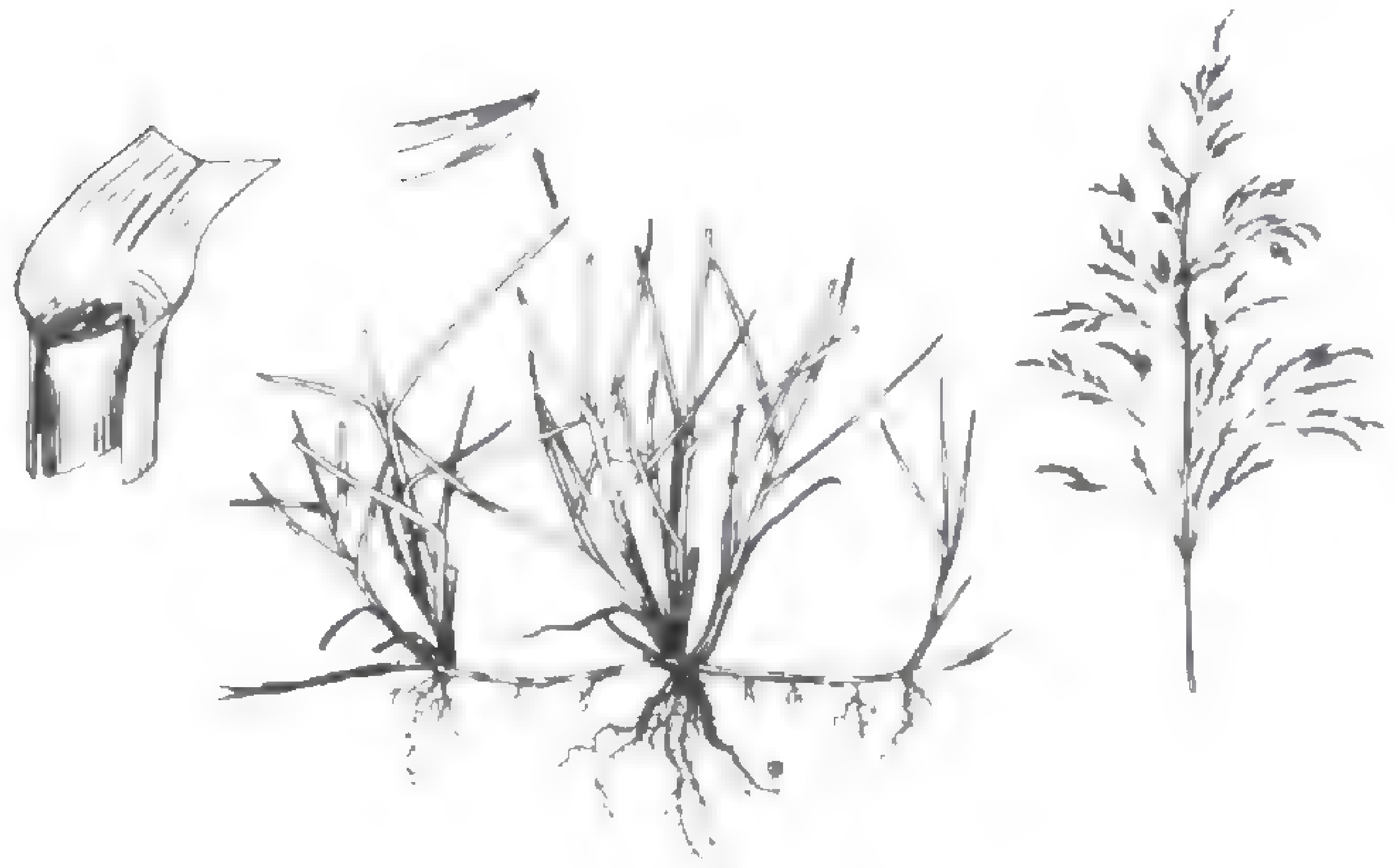
By observing a few summer precautions a bluegrass lawn in this area can be kept sparkling from early autumn until nearly Christmas, and from early spring until the hot weather of summer begins. During late July and August it will seldom remain attractively green and actively growing. Temporary browning of unwatered bluegrass during drought does not kill well-established turf, which revives immediately after rain. As a matter of fact, the weeds are generally hurt more by drought than is the grass, with ultimate benefits to the lawn as autumn approaches.

Annual Seedings. I will not argue whether annual, expendable seedings reflect defeatism, or a common sense approach to tough climatic conditions. Many middle latitude lawns are allowed to turn to crabgrass and weeds in summer, either by choice or unskillful handling. Mowed regularly, they are not necessarily unattractive. The repressed northern grasses might volunteer here and there in autumn, but if the lawn is to look well through winter, a uniform seeding must be made in autumn. Quality seed mixtures of bluegrass and fescue will sprout readily in a scuffed up "mulch" of old crabgrass. More frequently ryegrass is sown. This cover deteriorates in spring, until crabgrass once again takes over. When one hesitates to rely upon crabgrass, sowing the non-hardy bermuda grass seed is possible. It grows rampantly through the summer, only to die in early autumn as the cycle is renewed. This is an unending and often exhausting cycle. It will not provide a really top lawn, even though at certain seasons it is not unattractive. The program, if it can be called that, merits no further discussion, since seasonal summer-winter care parallels practices for southern and northern lawns.

THE GRASSES

The Bluegrass group (Poa). Lawn bluegrasses have boat-shaped or spoon-like tips to the leaves, easily felt by running the leaf between thumb and forefinger. Several species may volunteer, but only Kentucky bluegrass *(Poa pratensis)* is ordinarily needed for lawn purposes. Canada bluegrass *(Poa compressa)* sometimes shows up on poor soil, but makes a thin, scrawny turf. It can be recognized by its flattened stems.

Annual bluegrass *(Poa annua)* is frequent in spring, having volunteered from seed to produce a fine, bright green turf. Unfortunately it soon sets seed heads below cutting height of the



Poa pratensis—Bluegrass

mower. The plant, an annual, dies in late spring, leaving summer voids and weed problems. Annual bluegrass is usually considered a winter weed, although it would make an acceptable "winter grass" for lawns with summer bermuda or crabgrass. Rough bluegrass *(Poa trivialis)* is a frequent component of seed mixtures. It resembles bentgrass more than bluegrass, spreading by stolons, and forming dense colonies. It is adapted only to moist shady situations. While not harmful, it is of relatively little use in this climate.

The traditional source of Kentucky bluegrass seed has been that harvested from "wild" or volunteer stands, in the pastures and meadows of Kentucky and Missouri northward into Canada. Some sods have doubtless been there since colonial times. In any event this grass (termed natural Kentucky bluegrass by the trade) has endured the climatic, soil and disease tribulations for decades, without pampering. One would suppose that a certain amount of natural selection has taken place, such that in the myriad of strains adapted to specific local conditions, ecotypes, one would find in natural Kentucky bluegrass a suitable candidate for almost any lawn condition. Indeed, tests have shown that natural Kentucky bluegrass is quite flexible. Seed harvested in any portion of the range has proven adaptable to other sections.

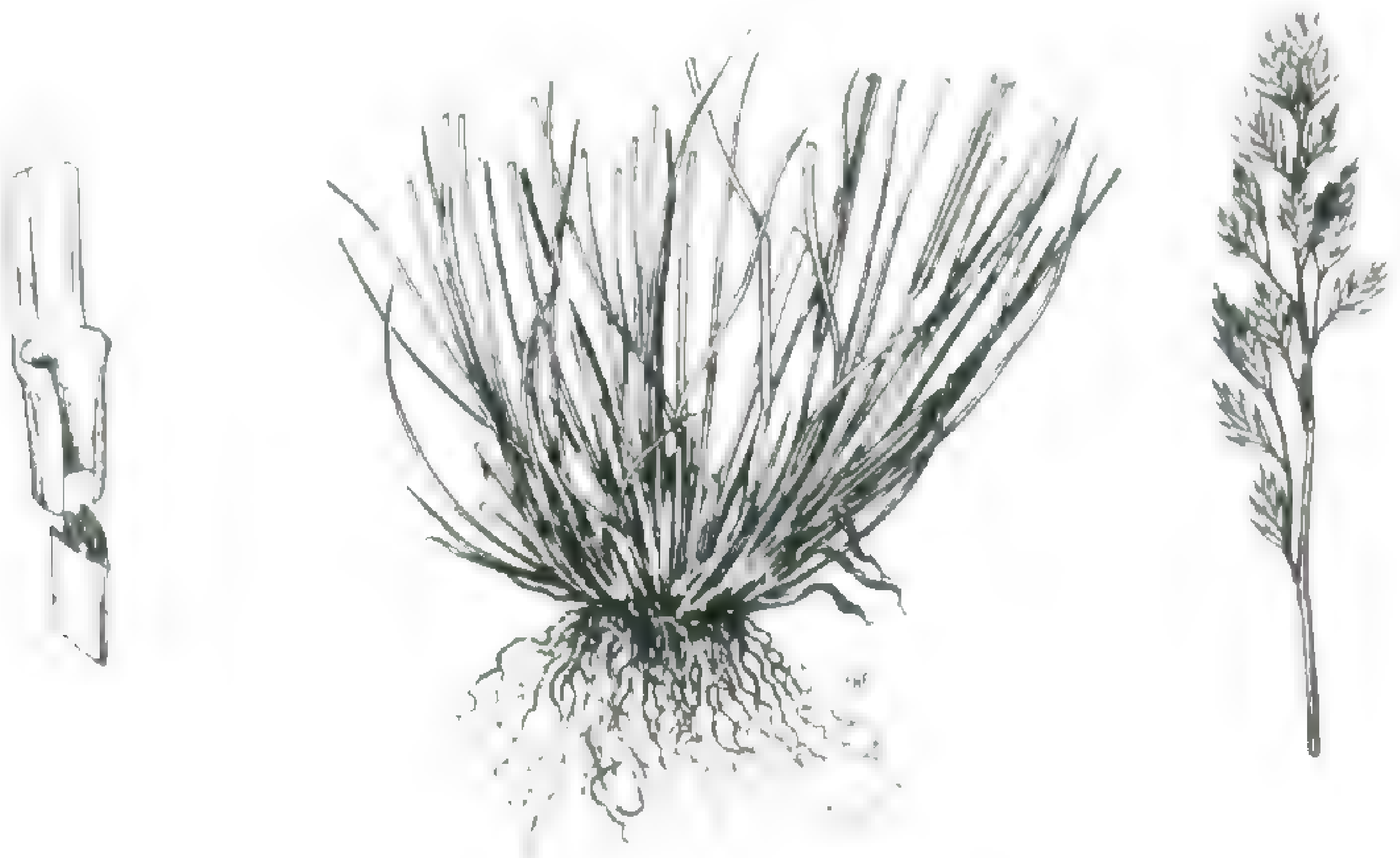
Plants selected for unusual appearance, resistance to disease, or suchlike, have been isolated and increased for seed in western regions where "contaminating" volunteer bluegrass is not a problem. Although such varieties may be excellent for the quality for which they are chosen, they can exhibit reduced endurance in lawns not just to their liking. *Merion*, the first widely-acclaimed variety, has an attractive low growth but it has not done too well in the southern portions of the bluegrass zone. Moreover, it is a heavy feeder, the seeds are slow to germinate and it is afflicted by rust in addition to some other diseases which cropped up after its original selection for resistance to leaf spot.

Newport is a tight growing selection with good autumn color, picked up on the Oregon coast. Final evaluation for this climate remains to be completed. *Park* is a selection from Minnesota, gained from intermixing a number of the more vigorous selections from that area. In appearance and performance it seems little different from natural Kentucky bluegrass, although the husky seeds provide quick sprouting, on a par with the best of natural Kentucky bluegrass. *Delta* is a selection from Canada, a good seeder, which appears little different than natural Kentucky bluegrass. *Arboretum*, a mass selection from the Missouri Botanical Garden Arboretum, is likewise similar to natural bluegrass. *Troy* is an imported selection from the Near East, which seems to have no especial advantages.

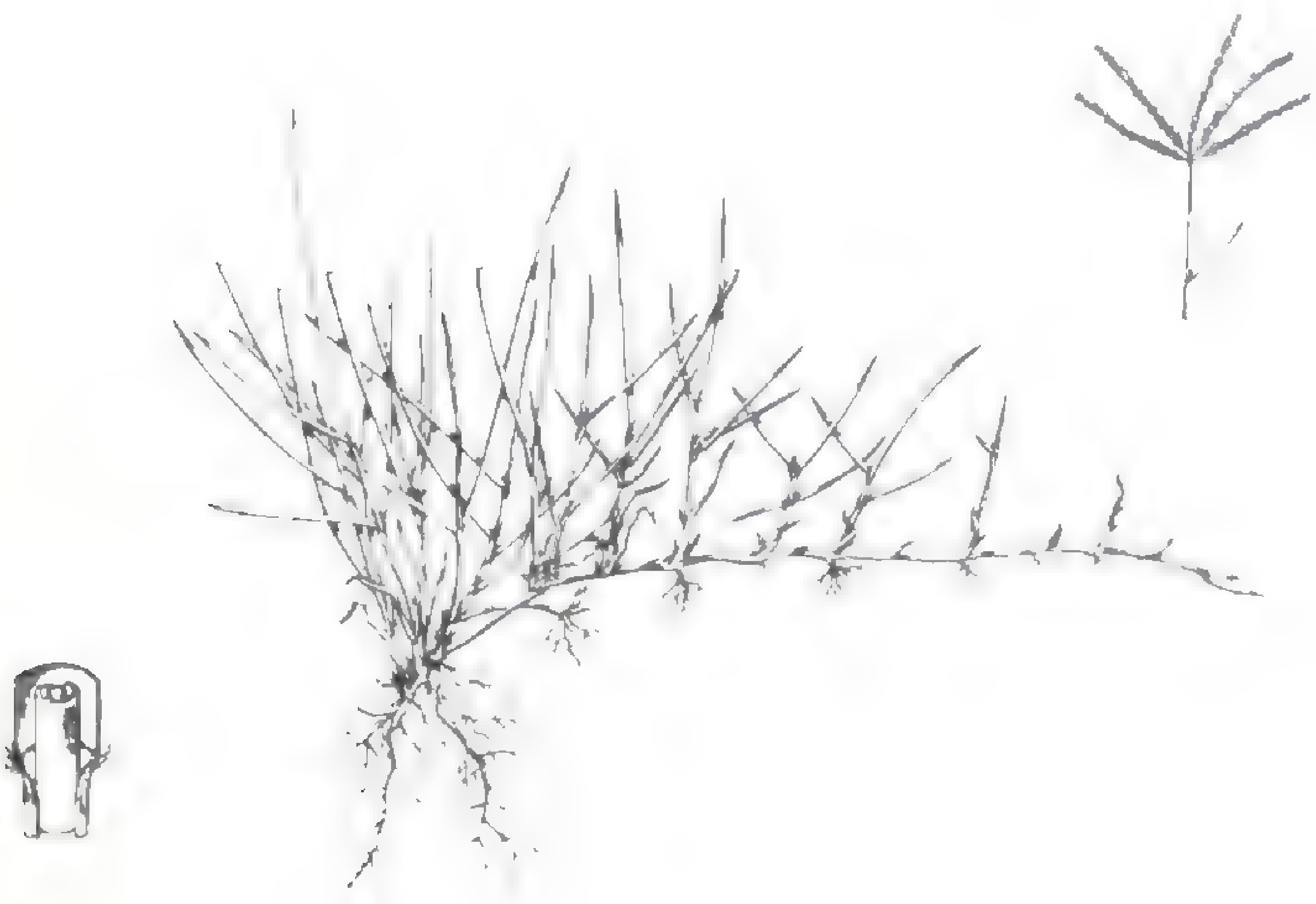
A great many other selections are under test, and will reach marketing in the years ahead. The experimentally-minded might want to try one or another named variety, but for average lawns a hard core of natural Kentucky bluegrass should serve well, perhaps embellished with one or more named varieties mechanically blended in. This gives a wide spread of candidates for the difficult summer conditions.

Red fescues (Festuca rubra in variety). The red fescue group, the better varieties of which come from Oregon, make admirable companions for bluegrass. They are tolerant of poor soils and shade. The seed is larger than that of bluegrass and provides seedling cover a bit more quickly, helping to lessen the need for so-called nurse-grasses. The red fescues' requirements are quite similar to those of bluegrass, and the two grasses blend well.

Red fescues have a thin, wiry leaf, similar to the sheep's fescue that volunteers in the shade of trees, especially under oaks in the area. They do not become clumpy, as does sheep's fescue. The difference between varieties is minor, although Chewings, Illahee,



Festuca rubra—Red Fescue



Cynodon dactylon—Improved Bermuda

Pennlawn, Rainier and others claim density advantages over the parent Creeping Red.

Bentgrass (Agrostis). Bentgrasses are seldom recommended for lawns in middle latitudes. The fine-textured species, creeping bentgrasses (*A. palustris* and *A. canina*) of golf greens, and more erect colonial types (*A. tenuis*, often included in seed mixtures) prefer humid climates with mild summers. They need constant attention to remain attractive. Redtop (*A. alba*) is a coarser species, frequently recommended as a "nursegrass." The theory is that it will cover quickly, then give way to better grasses. But certain redtop plants may persist for years, becoming coarse clumps that are hard to mow. However, with modern planting techniques such as mulching there is little need in any event for fast sprouting species, which only compete with the more desirable permanent grasses for space, moisture and nutrients, thus setting them back.

Ryegrass (Lolium multiflorum, Italian or annual ryegrass; *L. perenne,* perennial ryegrass). Annual ryegrass is the chief component of cheap seed mixtures. Perennial ryegrass is not much longer lasting than is annual in mid-latitudes. Neither can be recommended except for temporary winter overseeding. They are coarse bunchgrasses without rhizomes or stolons. They should not be used as a nursegrass in seed mixtures, at least in any sizable percentage, for they are even more competitive in new seedings than is redtop. I would not recommend them even for temporary summer seedings, since some seed may persist in the soil to become troublesome when the permanent lawn is planted in autumn.

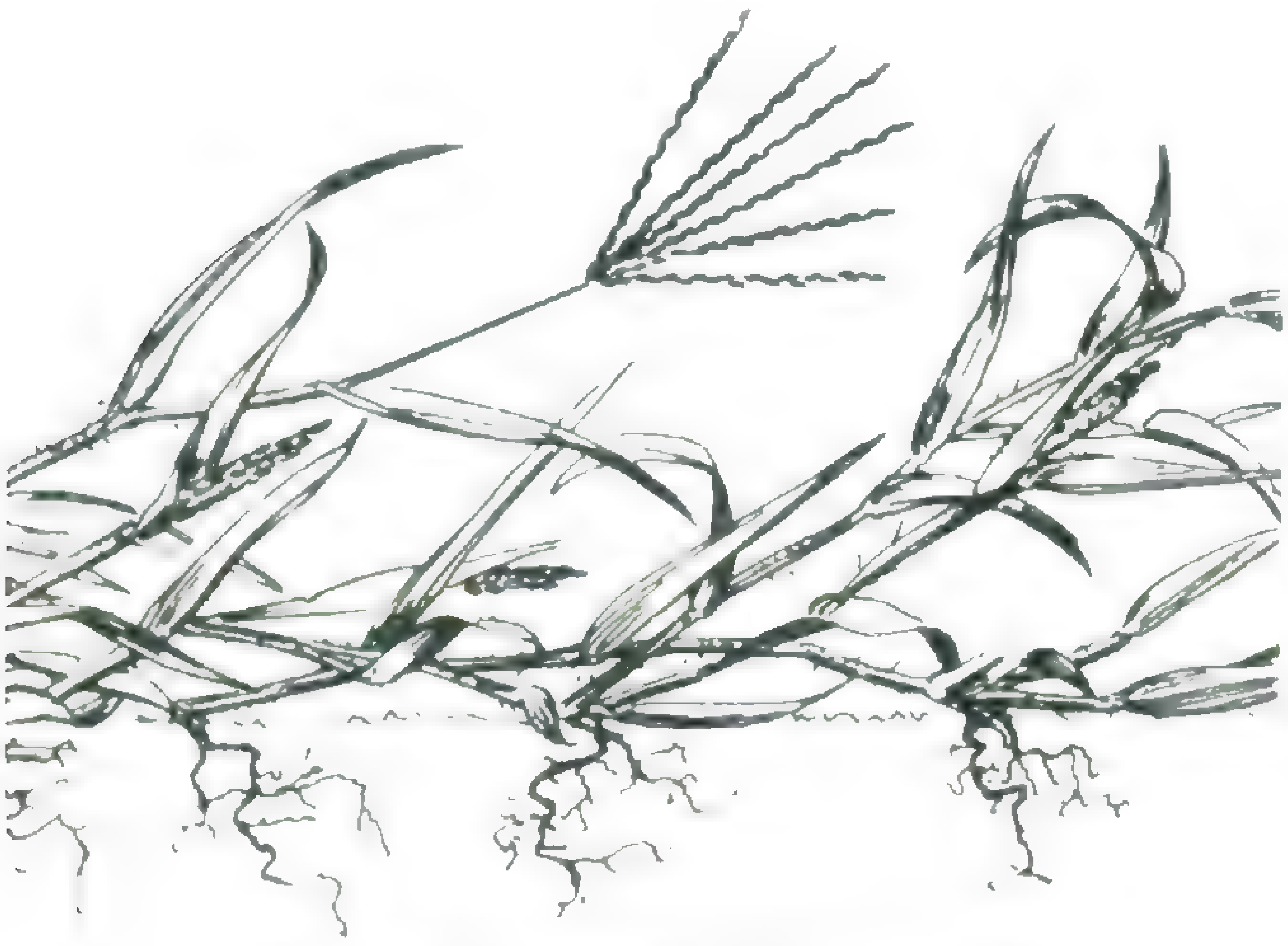
Summer Grasses

Bermuda (Cynodon dactylon). Common bermuda grass from seed yields a mixture of types which provide attractive turf, if well maintained. It is open enough to be interseeded with "winter grass" as it browns in early autumn. Bermuda grows only during hot weather. It is seldom possible to achieve good cover before late May.

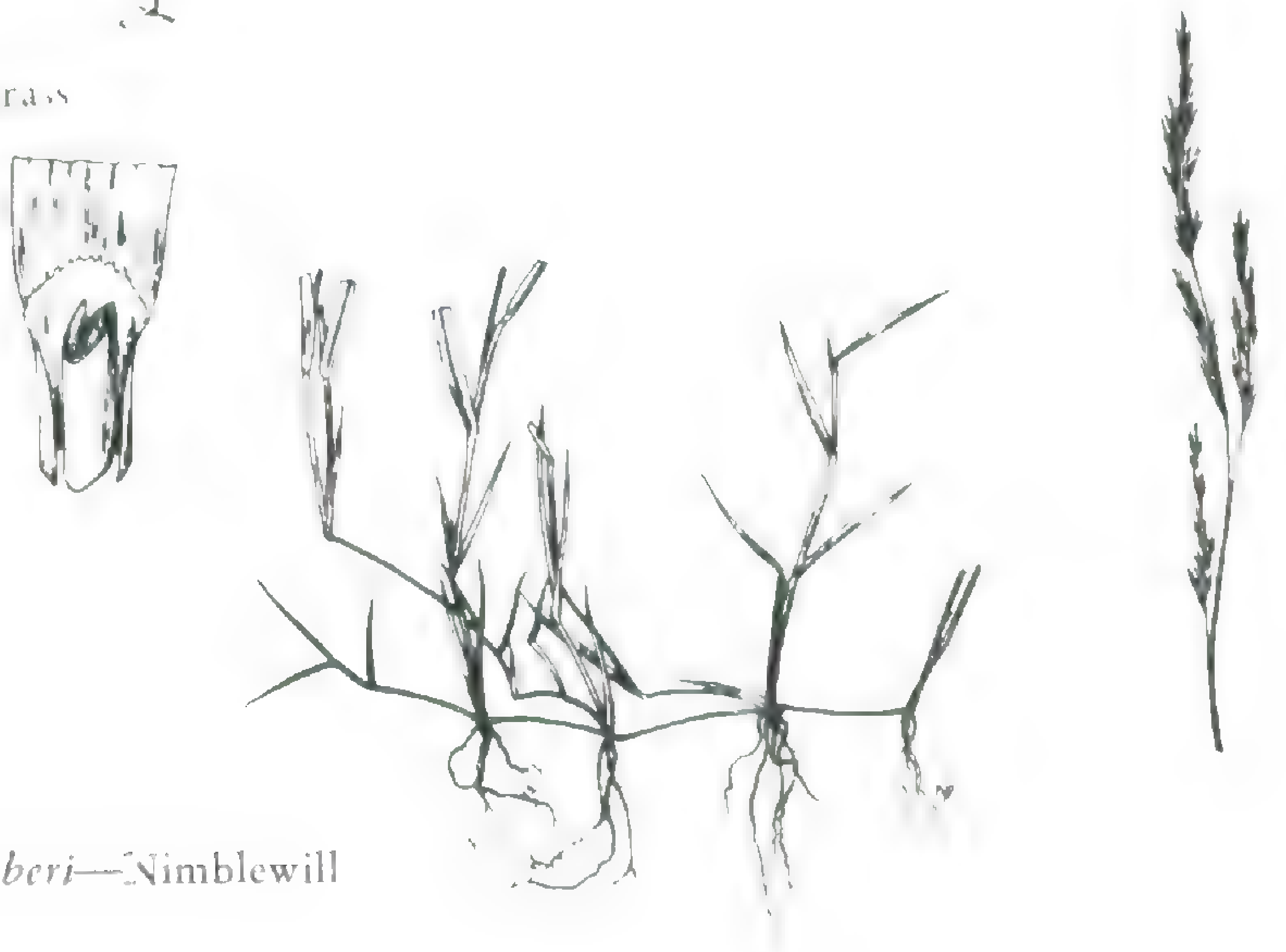
Several selections have been chosen, perpetuated by vegetative (hand) planting. U-3 has survived most mid-continent winters. *Sunturf (C. magenesii)* is a presumed natural hybrid from Africa, probably hardy. Varietal selections made at Tifton, Georgia, *(Tiffine, Tifgreen)* seem to survive most winters in this area, too. The difficulty and expense of planting lessens their appeal. Local nurseries can supply plugs of sod which are planted the same as potted plants, or sprigs which may be scattered over cultivated soil, topdressed a bit, and kept continuously watered until rooted.

Crabgrass (Digitaria). Two intergrading species are common, *D. sanguinalis*, hairy crabcrass, and *D. ischaemum*, smooth crabgrass. Crabgrass is perhaps the most insidious summer weed of the area, spreading by trailing stems and gradually smothering out all competing vegetation. On the other hand, it does make a summer cover not too unattractive, where no better turf is maintained. In general, we would consider crabgrass a weed and call for its elimination according to instructions in a later section.

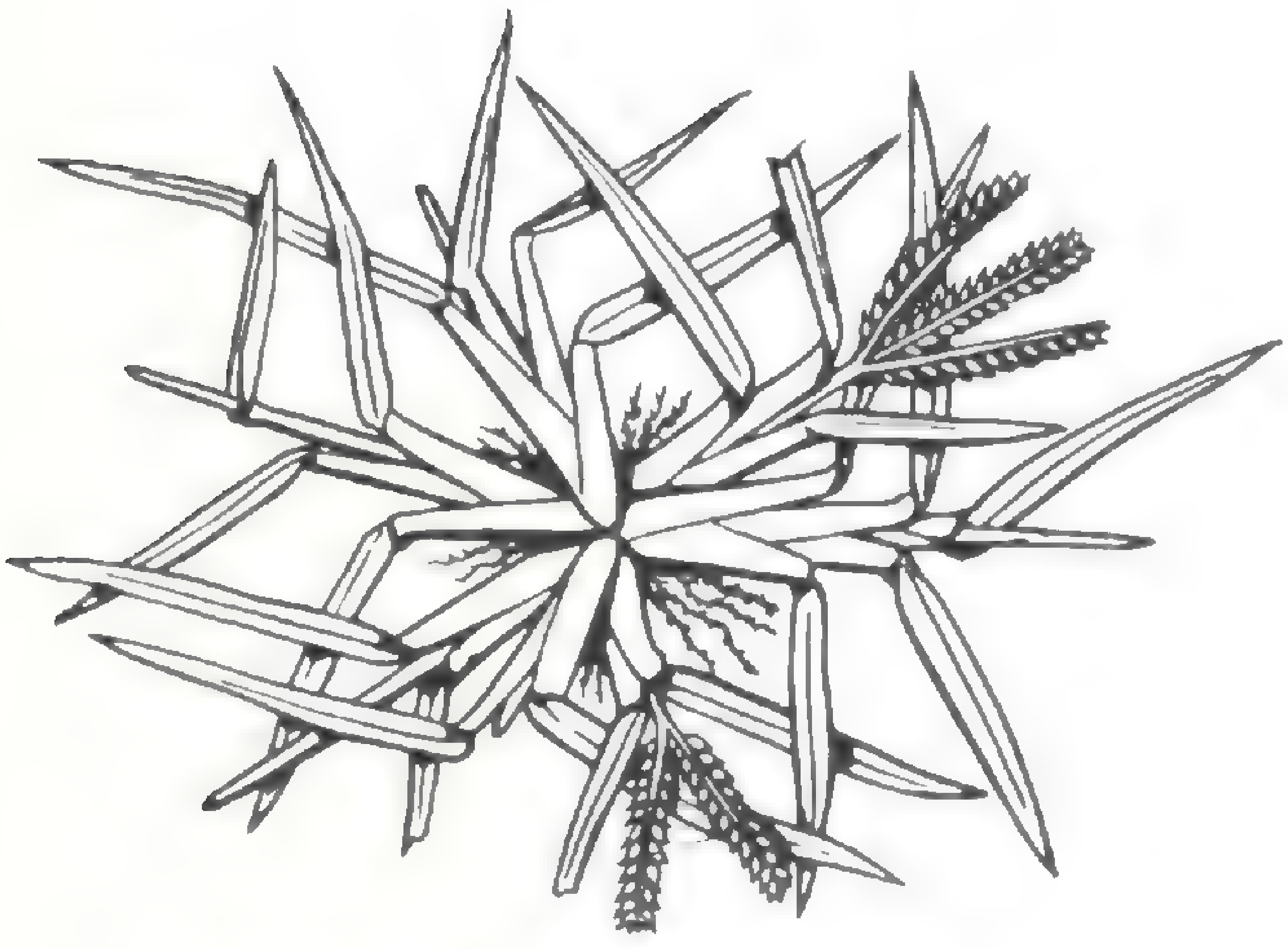
Nimblewill (Muhlenbergia schreberi). Nimblewill has become quite a pest over the entire Midwest, and in many areas surpasses crabgrass as a source for complaint. It is a dark bluish-green, and often seems to prefer partial shade where crabgrass never grows. It has knob-like joints on the trailing stems, Like bermuda or crabgrass, it is slow to gain color in spring, and quick to



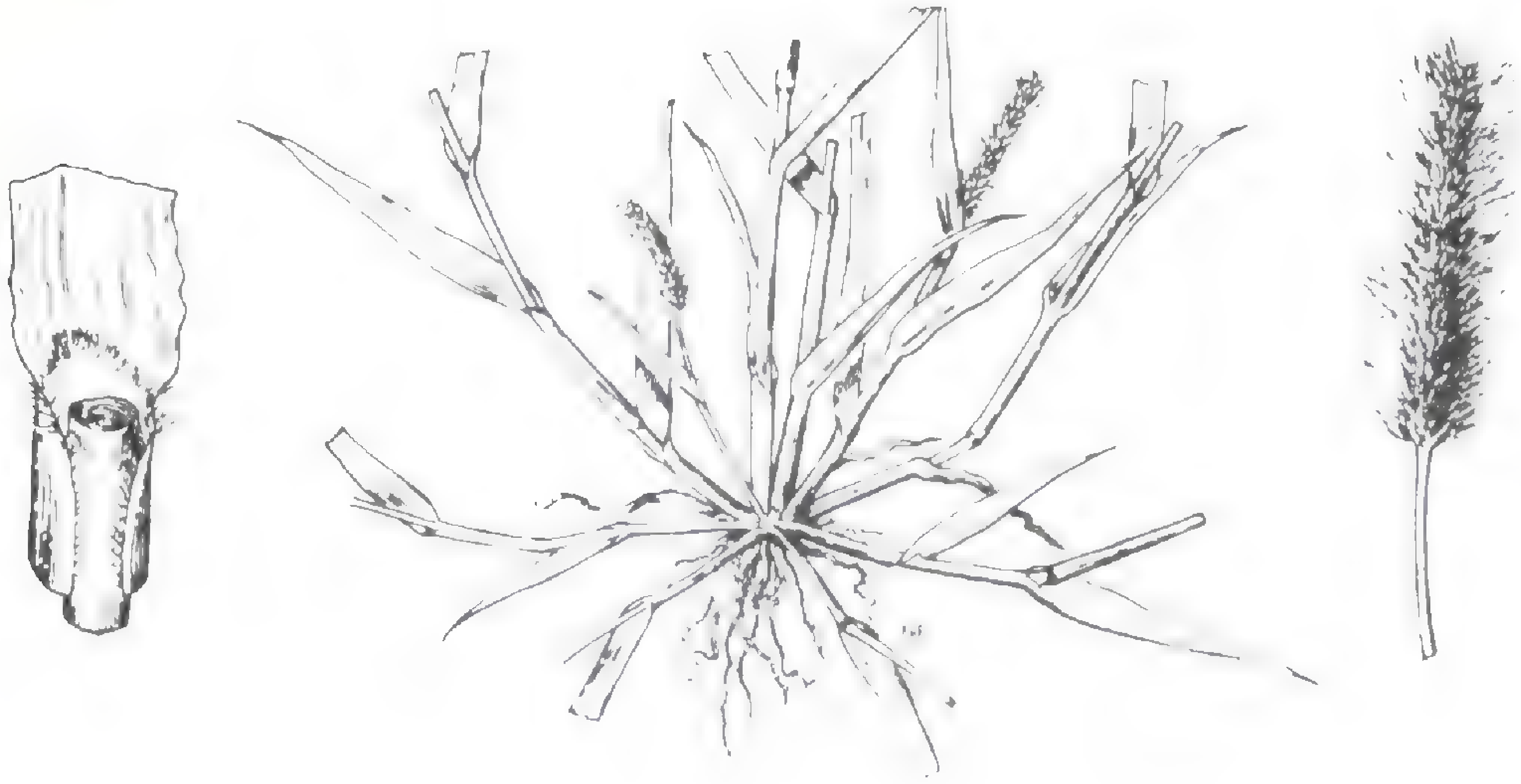
Digitaria spp.—Crabgrass



Mulenbergia schreberi—Nimblewill



Eleusine indica—Goosegrass



Setaria viridis—Green Foxtail

go off color in autumn. During late summer it enlarges into heavy patches that crowd desirable grasses. There is no selective way to eliminate nimblewill. Hand pulling where infestation is light is suggested, or spot-treatment with a herbicide and reseeding. Planted grasses, well-tended, may in time overwhelm nimblewill.

Goosegrass (Eleusine indica). Goosegrass is often confused with crabgrass, to the dismay of homeowners who try to kill it with crabgrass remedies in the usual manner. It has a flattened stem and does not spread and root at the joints as does crabgrass. An annual, moved northward from the tropics, it flourishes primarily on hot compact soils unfit for its betters. In good turf it seldom is a problem, but often it can be eliminated by repeated treatments with crabgrass chemicals such as DSMA.

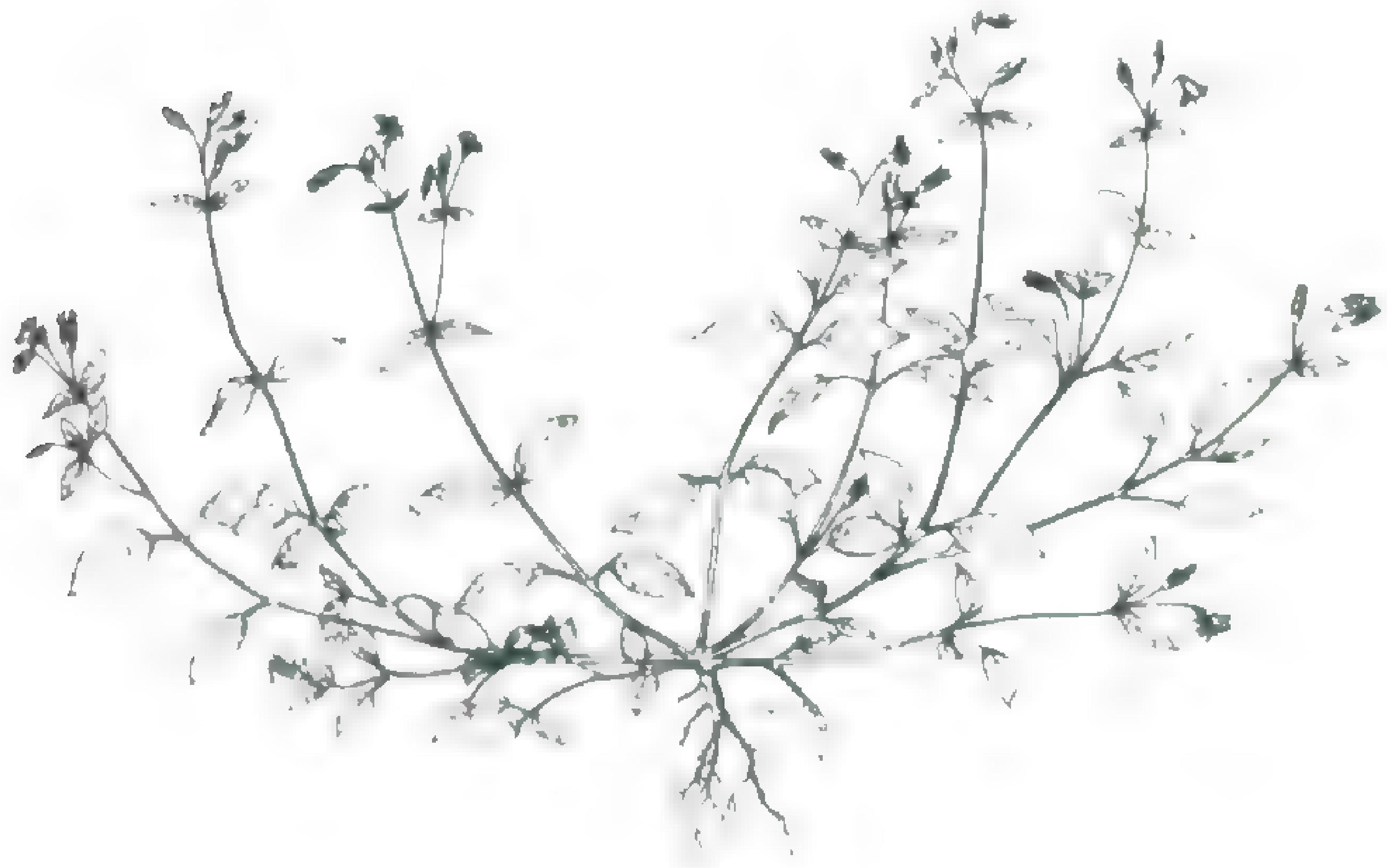
Foxtail (Setaria sp.). The foxtails occur primarily in new lawns and give way in time to the established turf. They can be recognized in the late autumn by the burr-like seedheads. DSMA speeds their disappearance.

BROAD-LEAF WEEDS

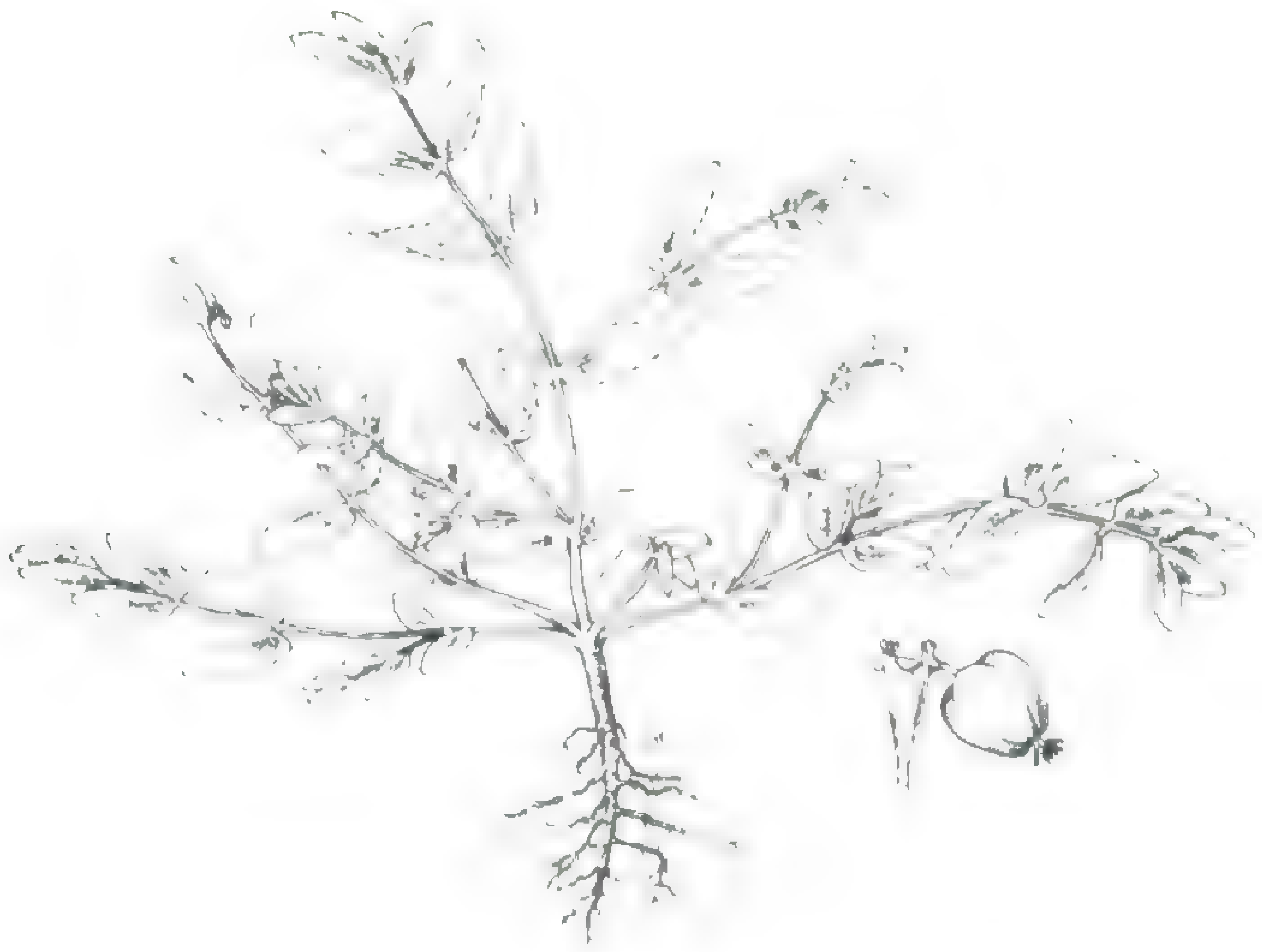
Broad-leaf or dicotyledonous weed possibilities for local lawns are too numerous to list completely. Some of the greatest pests of former years, such as dandelions and plantains, are so easily controlled with the 2,4-D group of chemicals as to be but a minor inconvenience. Even chickweed is becoming readily controllable with several weed killing chemicals applied in autumn or early spring.

The chief lawn weeds appearing from autumn through early spring, are henbit *(Lamium amplexicaule)*, chickweed *(Stellaria media)*, and various cresses (members of the *Cruciferae)*.

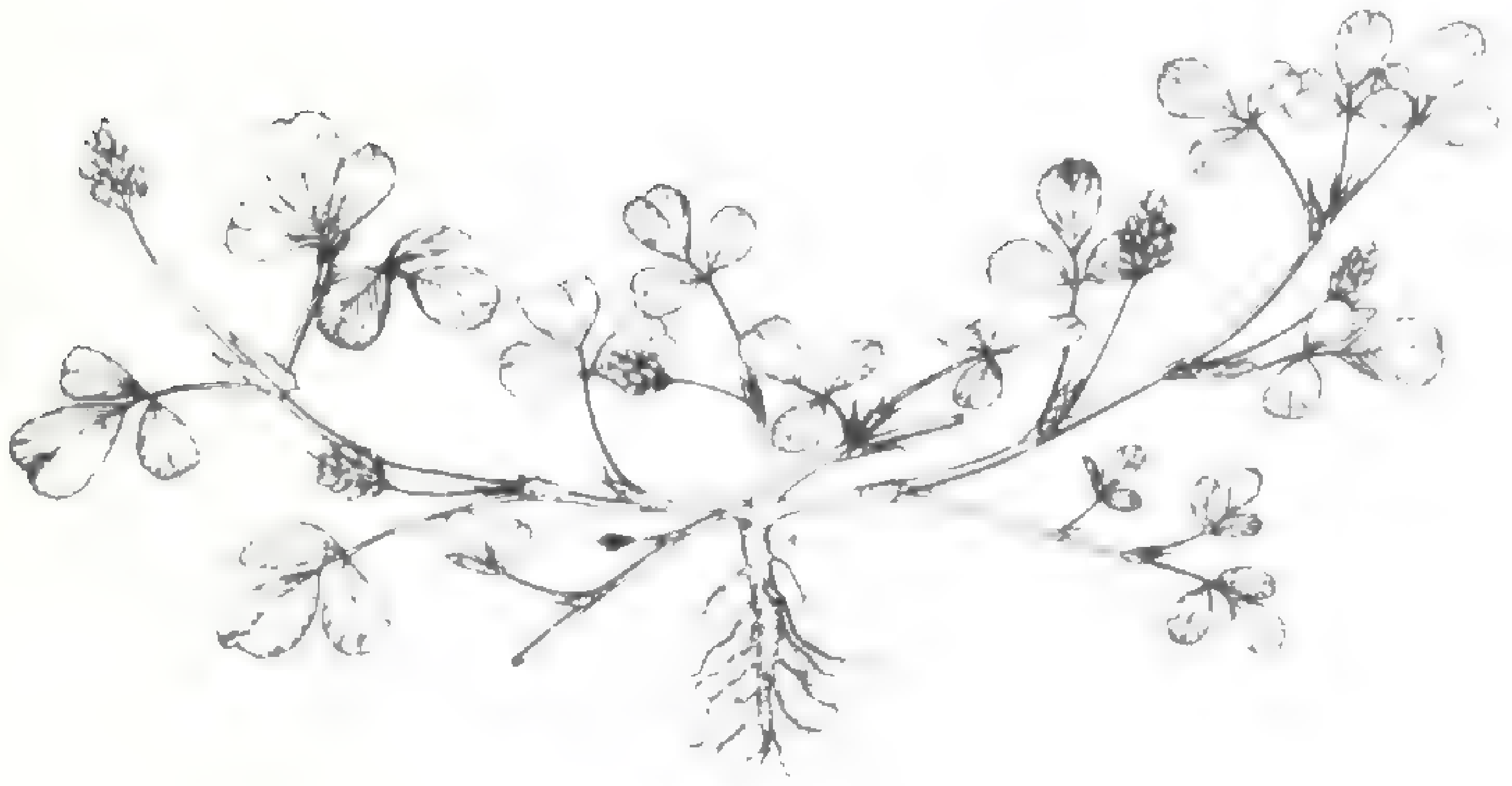
Weeds prominent in hot weather are the dandelions *(Taraxacum officinale)*, the plantains or buckhorns *(Plantago major, P. lanceolata)*, clover *(Trifolium repens)*, knotweed *(Polygonum aviculare)*, spurge *(Euphorbia maculata)*, carpetweed *(Mollugo verticillata)*, milfoil *(Achillea millefolium)*, and black medic *(Medicago lupulina)*.



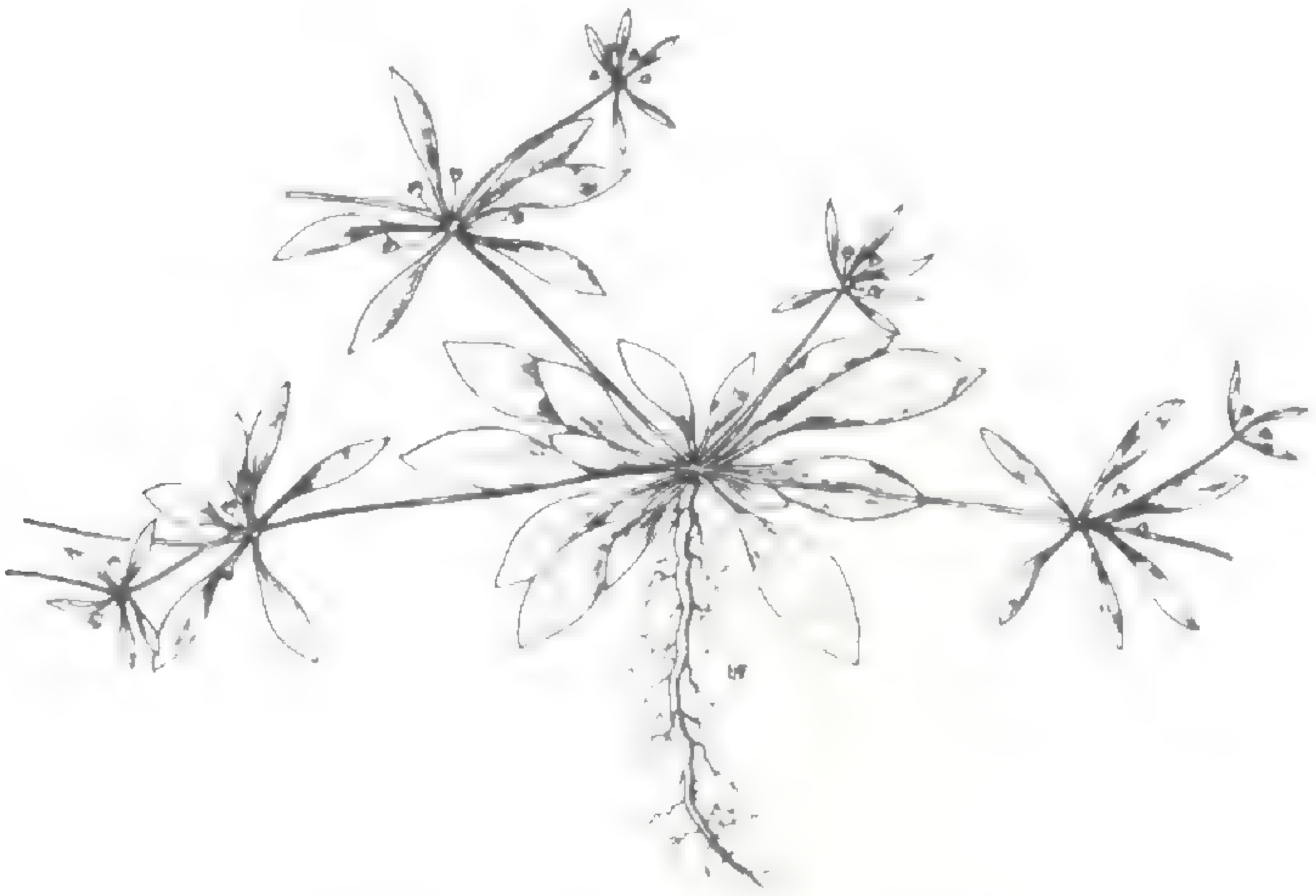
Stellaria media—Common Chickweed



Euphorbia maculata—Nodding Spurge



Medicago lupulina—Black Medic



Mollugo verticillata—Carpetweed

Preparing the Seedbed

A number of good lawn books deal extensively with seedbed preparation. Proper grading and drainage should be attended to at the time of house construction. Topsoil importation is a declining procedure, since topsoil is generally expensive and may be of poor quality and full of weeds. Satisfactory results are usually possible by mixing plenty of fertilizer into the residual soil and letting the grass build up the organic content. Compacted soil, a familiar condition after home construction, should be loosened to a depth of three or four inches. This is best done with power equipment, a tractor-pulled disc or rotary tiller.

A phosphatic fertilizer might be mixed in profitably at last cultivation, since phosphorus moves only slowly through the soil and may not reach the root zone for some years when applied at the surface after the lawn is up. There is no need to pulverize the seedbed, as this only contributes to crusting upon watering. Soil clods about the size of pebbles resist slaking longer than does a dust-fine surface.

Nor is there ordinarily any need for rolling a new seedbed, other than perhaps to point up low spots during leveling. It is especially unwise to use a heavy roller or any heavy equipment on a wet clay soil, which would recompact the soil, undoing the benefits of cultivation.

Most soils of the area are not very deficient in lime. The only sure way to know, however, is to have a soil test for pH. If the test shows acidity at 6 or lower, apply crushed agricultural limestone at the rate of 50 to 100 pounds per 1000 square feet. Organic residues or soil conditioners such as peat, compost, sawdust, vermiculite, may help loosen heavy soils, and make watering and initial attention a bit less difficult but they contribute little fertility and are laborious to mix into the soil.

SEEDING AND MULCHING

After the seedbed has been leveled, the next step is to sift a good seed

A spreader is convenient for even regulated distribution of seed, fertilizer and other lawn materials.

mixture uniformly over the surface. Upon watering, seed will settle among the soil clods if the surface has been left pebbled. Raking or rolling are seldom needed.

A number of helpful mechanical devices are sold for spreading seed, fertilizer and other lawn materials quickly and uniformly. The cyclone, whirlwind-type is the quickest and easiest, although the drop-from-hopper spreader carts are usually a bit more accurate. Quality seed mixtures, mostly bluegrass and red fescue, should be sown at rates of about 3 or 4 pounds per 1000 square feet. If previous application of fertilizer was neglected, it can be applied along with the seed, without harm, for initial watering will wash the seed free from sprout-inhibiting salts. Ten to twenty pounds per 1000 square feet of such lawn fertilizers as 20–10–5, 15–5–5, or 10–6–4 are appropriate.

The better grasses are not so quick to sprout as are coarse haygrasses. Where humidity is constantly maintained and temperatures are mild, good seed should be showing green in about a week. With bermuda grass, seed with the hulls removed is faster to sprout than that not hulled.

A mulch after seeding is certainly worth applying. The usual mulch is straw, scattered evenly to a depth of 3 or 4 straws. Other inexpensive, loose materials may be used, and there are even prepared nettings (Erosionet) sold for the purpose. A very quick way to get seedlings started, especially in the cooler, dry weather of autumn, is to cover the planted and once-watered seedbed with clear polyethylene plastic, tacked down around the edges with large-headed nails or wire wickets. The system is self-irrigating, in that water evaporated from the soil condenses on the plastic and drips back again. Also, this "plastic greenhouse" traps heat during the day, causing faster sprouting if weather is cool. Be careful not to let too much heat accumulate under the plastic on warm sunny days, for temperatures much above 100° F. can kill moistened seed within a few hours.

When to Plant

The most effective season to plant a northern grass blend is in early autumn, just as soon as soil moisture has been replenished. The seedbed might be prepared in August, when dry soils and tillage combine to kill the weeds. In mid-latitudes watering sufficiently to soak a seedbed, and keeping the surface moist, is certainly expensive, if not impossible. Therefore, seeding might best await the first soaking rain of September. Once soaked, frequent light syringings can keep the seedbed moist, to bring the grass up quickly. Adding a mulch would help retain moisture and make the job easier.

Other advantages of autumn seeding are: the shortening days, which lessen moisture evaporation; a season when most weeds are declining although a few winter weeds such as cresses are just beginning; warmer, drier cultivatable soils; and more time for lawn making, free from the press of spring chores.

If, for any reason, seeding is missed in early autumn, it is still better to sow seed late rather than the following spring. Even if the seed does not sprout, it will remain unharmed in the soil for an early start in spring.

If autumn seeding is impossible, it may be worth taking a chance in spring rather than to wait a whole year. In such instances perhaps soil tillage can be skipped, if the seedbed had been sufficiently leveled and settled beforehand. The seed may be spread in late winter or very early spring on a frost-pocked soil surface. Nature cultivates the soil by freezing-thawing through the winter, and seeds will sink into the alternatingly pitted and thawed surface. It will be slow to sprout in the cold soil of spring, but still ahead of sowings that await the drier weather of late April or May for soil preparation.

Late spring and early summer seedings are seldom to be recommended here, although in some years when summers remain luckily cool, or where special conditions, such as slope or shade, favor the cool-weather grasses, success may be possible. But summer seeding is a risk and entails a lot of work keeping new seedings watered. Ordinarily we would suggest sowing a temporary cover to get through the summer, then seeding permanently in early autumn. A useful temporary cover for middle latitudes is Korean lespedeza. This legume is reasonably attractive, yet will not persist and be competitive with later grass, as would ryegrass, redtop or clover.

Bermuda grass seedings, or bermuda and zoysia vegetative plantings, should be made only after the weather has warmed in spring. There is little point in starting either one later than mid-summer, since at least six weeks are needed for establishment and spread. Sprigs or plugs started late may not withstand winter.

MAINTAINING THE ESTABLISHED LAWN

In the following paragraphs, under appropriate headings, the major lawn care procedures are reviewed. In each instance discussion centers primarily upon the bluegrass–fescue lawn. Qualifications for southern grasses are pointed out where this is necessary.

Mowing. The opening pages emphasized the importance of mowing-to-fit-the-species in troublesome mid-continent climates. Of all mismanagement possibilities, close clipping, called scalping, is probably the most disastrous for the bluegrass–fine fescue lawn in this area. The mower should be set at least two inches high through the growing season; after the grass leaves are browned by bitter winter weather, a single close cut in early March can reveal more quickly the bright new leaf tips of spring. Three-inch mowing through summer would be even better, and is in itself an excellent crabgrass control.

Obviously mowing height has implications for choice of mower. Reel mowers cut rather poorly when set high, because the grass is "blown down" ahead of the blades, rather than being sucked up as with a rotary. Thus for the bluegrass–fescue turf, favored by high mowing, rotary mowers are suggested, and those with simple height adjustment to 2 or 3 inches.

For bermuda grass and those infrequent bentgrass lawns, a closer mowing is necessary. A one-inch cutting height keeps these trailing species presentable. Zoysias are usually mowed at an intermediate height, say about 1½ inches. Zoysia is an unusually tough grass; poorly constructed mowers may have a struggle keeping it mowed. For bents, bermudas and zoysias, reel mowers are satisfactory. Older reel mowers have only five blades, an economy feature, and do not mow as attractively as six-bladed machines.

With bluegrass–fescue lawns, clippings can usually be left without harm or unsightliness. These species grow upright, and the clippings, unless long from too infrequent mowing, settle near the soil, generally decaying in the warm humid weather without making a mat. Since clippings during the year contain nutrients equivalent to a fertilizer application, leaving them on the lawn makes sense if they do not detract from the appearance. It has been demonstrated that soil aggregation and water penetration are improved under grass clippings, although on a flourishing lawn such a ubiquity of fine rootlets occurs that soil offers few structural problems.

Bentgrass and bermuda are vigorous growers. They must be mowed frequently and be "pushed" for new leafage by fertilizing and watering if they are to look well. The mat formed by layers of undecomposed vegetation may build up under this intense management. This mat insulates the soil from air and moisture, and eventually smothers out the grass. Collecting clippings helps forestall a mat. Where a mat has accumulated, thinning should be undertaken, by vigorous raking before mowing, or in extreme cases, with special spiking or vertical-cutting machines.

A mowing schedule is hard to suggest. The best general recommendation is to cut at any time the grass has added 50% to its desired height, usually one inch for bermuda grass and two to three inches for bluegrass–fescue. Removing more than one-third the green leafage stalls root growth. Bluegrass lawns grow most in spring and may need little mowing in summer. Bermudas need frequent cutting all summer. Zoysia is a slow grower, although to look spruced up, it should be clipped weekly.

More time is spent on lawn mowing than on anything else. It behooves the lawnsman to pass the time as pleasantly as possible. Mowing can be relaxing and pleasurable if good equipment of sufficient size is secured. Do not cut corners in purchasing a lawn mower. Chose a durable make, designed for convenient operation and manipulation, and one that starts readily, that is large enough to mow the whole lawn in a reasonably short time. There are several semi-automatic starting devices. Practically everyone uses a power mower nowadays, and the riding types give many oldsters an excuse for youthful excitement without seeming silly.

Fertilization. The source of a nutrient matters little to the grass, just so it is available when needed. However, for lawn tending convenience, differences in fertilizers can be important. Many fertilizers are custom-tailored especially for lawns, and lawn spreader application. The most economical fertilizer consists of simple chemical salts that release ammonium, nitrate, phosphatic compounds, and potassium. The nutrient elements are largely soluble and become available to the grass immediately upon application and watering. Pelleted or granular forms are safer than dusty formulations, since the pellets roll from grass foliage to the soil and cause no burn. Soluble fertilizers for application in water, as with siphon attachments to the hose, are concentrated materials of this type. Per unit of nutrient they are usually considerably more expensive than are dry chemical fertilizers.

Practically everyone uses a power mower nowadays.

Organic fertilizers pack less power, and are somewhat more expensive per unit of nutrient. Manures fall in this category, and packaged products from tankage, vegetable wastes, dried blood, treated sewage, etc. The nutrients are released only as decomposition proceeds on the lawn. Hence, organic fertilizers release the nutrients more slowly over a longer span of time, and will not "burn" grasses as readily as do chemical types.

In recent years man has imitated the organic fertilizers by tailor-making complex molecules, the urea-forms, from urea and formaldehyde, which break down slowly at a determinable rate. Similar results are obtainable by coating the pellets of chemical fertilizers with resin which breaks down slowly. In either instance the objective is gradual release of nutrients.

Most lawn fertilizers are composed of two or more of these types, and contain some quickly soluble nutrients for immediate effect as well as slower-release components. The slow-release of nitrogen is especially useful for the southern grasses which continue growing all through the warm season and should have even stimulation for uniform growth. With a northern lawn, which in this climate goes partially dormant in summer due to hot weather, the less expensive chemical fertilizers might serve well. Bluegrass' main need for feeding is in the autumn, the season when it builds up its reserves. Nitrogen supplied then is trapped by the grass and soil, and is carried without much loss until used by the grass.

Except for the bermudas and zoysias, summer feeding might well be minimized. Nitrogen in hot weather benefits the weeds more than the grass, and indeed may encourage such lush leafage that this falls prey to disease. For the mid-continent bluegrass lawn one or two generous feedings in autumn, with perhaps a lighter spring feeding, should suffice. Of course, variety of grass, local soil fertility, and general maintenance practices will dictate fertilization needs. But do be cautious about stimulation in late spring and summer. Even in early spring excess fertilizer can intensify leaf spot.

In fertilizing the lawn, follow the rates recommended by the manufacturer. Usually one to two pounds of available nitrogen is supplied per 1000 square feet, that is, ten to twenty pounds of a 10–6–4 mixture, which is 10% nitrogen. In a fertilizer analysis nutrients are always listed in nitrogen–phosphorus–potassium order, as the percentage contained.

If misapplied, any fertilizer, even limestone, can burn the grass. Spreaders should be filled off the turf, checked for complete shut-off when stopped or turned on the lawn. Even moderately excessive rates of chemical fertilizers may discolor turf during hot weather. The organics and synthetic organics are less apt to cause this trouble.

Bolster Seeding. An occasional overseeding has merit, for even with the best of attention there is apt to be some turf loss or thinning. Having proper candidate grass plants ready for voids makes correction easier. A half-rate bolster seeding in autumn or early spring can provide insurance at little cost. As with seeding a new lawn, overseeding is most conveniently and accurately carried out with a spreader, the same machine used for fertilizer and other dry materials.

Weed Control. Earlier pages list some weeds that are prominent members of the lawn community. Their elimination by mechanical or chemical means will be only temporary, unless weeds are replaced by grass. Thus, the first step in weed control is good general lawn maintenance.

Fortunately, the day of having to handpluck weeds has largely disappeared. There are now available chemicals which will selectively eliminate most weeds with little or no injury to the grass. The major breakthrough on this front was 2,4-D (2,4-dichlorophenoxyacetic acid), which, at rates used, affects most dicotyledonous plants while not injuring grasses. Numerous 2,4-D sprays and granular concoctions today easily rid the lawn of dandelions, plantains, young knotweed or spurge, ground ivy *(Glechoma hederacea)*, and several winter weeds. Use this spray only on warm, windless days. Minor alterations of the 2,4-D molecule have yielded such compounds as 2,4,5-T and 2,4,5-TP (silvex), which kill certain weeds resistant to 2,4-D, such as clover, oxalis, mouse-ear chickweed and other tough customers.

The 2,4-D family of chemicals is effective at exceedingly light rates, usually not much over one pound of acid per acre. Marketed formulations are seldom hazardous if directions are followed carefully. Nevertheless, weed killers, mishandled, can be dangerous. Not only may they injure the grass if over-applied, but drift or volatilization may bring injury to shrubbery and ornamentals. Tomatoes are especially susceptible to slight traces, and redbud suffers from silvex applied yards away.

Selective control has not been quite so easy with grass weeds in grass. The search has centered mainly on crabgrass herbicides which will not injure lawngrass. Fortunately bluegrass and fescues are among the more resistant species, so that a number of products have been found which will eliminate the annual grasses without serious discoloration of these perennials.

There are two approaches to the elimination of crabgrass and other annuals, such as goosegrass, foxtail and even chickweed. A "chemical blanket" may be spread on an established lawn before crabgrass sprouts; the pre-emergence way. Treatment may be made in autumn, although spring application before soils warm to the crabgrass sprouting temperature of about 60° F. lessens chance of dissipation of the chemical.

Various arsenic materials at relatively high rates, 15 to 25 pounds per 1000 square feet, control crabgrass and other sprouting seeds. Arsenic is a dangerous poison and can build up soil toxicity if over-applied. Be careful when using or handling calcium arsenate, lead arsenate or arsenical mixtures such as PAX. Chlordane, an insecticide, is reasonably effective as a pre-emergence herbicide at 1½ to 2 pounds per 1000 square feet. There seems to be little danger from over application of this chemical. Zytron and Dacthal are newer developments, quite effective at rates even lighter than chlordane.

Post-emergence control involves treatment of the crabgrass plant after it has sprouted. Potassium cyanate and mercury compounds (PMAS) have served more or less effectively through the years, but the arsonates (DSMA, AMA) have superseded them. Two applications of arsonate about a week apart kill crabgrass, goosegrass, dallisgrass *(Paspalum dilatum)* and even mouse-ear chickweed *(Cerastium vulgatum)* which is rather resistant to 2,4-D. For common chickweed, a familiar spring problem in the area, 2,4-D applied in warm weather, or combined with arsonate, and silvex, and neburon have proven effective.

Weeds are more susceptible to chemical control when growing vigorously. Treatment thus works best on mild days after rain. Also, weeds succumb more readily to herbicides in their younger stages. Knotweed and spurge become notoriously resistant late in the summer. Wild onion *(Allium sp.)* needs repeat treatments with 2,4-D, perhaps over a series of years, in mid-spring and autumn.

For some weeds there are still no selective controls, for perennial grasses especially, such as quackgrass *(Agropyron repens)* and nimblewill. The best that can be recommended is hand pulling, or spot treatment with non-selective herbicides such as dalapon, TCA, amino triazole, simazin, even gasoline or kerosene. Replanting must follow, of course.

Watering. The summers are few in which lawns will continue green and growing all season without supplemental watering. For constantly green turf, there is not much choice, even though in climates such as this, adequate irrigation can be difficult and expensive. In July and August at least one inch of water per week, evenly spread over the lawn, would be required, in default of rain. It must be applied slowly enough to soak in. A sprinkler system of sufficient capacity, adequate water pressure in the mains, and no restrictions on watering are all necessary. In hot weather midday watering can sacrifice as much moisture to evaporation as sinks into the soil, at least with small droplet sprays, the kind recommended for new seedings. Seldom is the investment for really adequate equipment merited, as might be the case in arid climates, viz., underground piping systems and high capacity outlets, such as used in Los Angeles and Denver, since watering in the mid-continent is for only a short season.

As suggested earlier, lawn watering is not an unmixed blessing. Southern grasses benefit from watering more than the northern ones, because summer is their most active season. Sprinkling very frequently helps the weeds more than the northern grasses. Bluegrasses and red fescues are partially dormant because of high temperatures. Crabgrass thrives on frequent light wettings. Excessive crabgrass from haphazard watering could cause more lawn damage than drought, at a season when northern grasses are least well equipped to fight back.

Watering should be prolonged enough so that moisture seeps all the way down to damp subsoil. On the heavier silt and clay soils this might require slow sprinkling for several hours. Be certain of deep penetration by cutting out a soil plug, and noting dampness all through the root zone.

Watering can be initiated when grass seems on the verge of wilting, marked by a bluish cast, and a tendency for footprints to persist because the turf lacks its usual resiliency. One soaking per week should suffice to carry grass to the next "verge of wilting." Meanwhile the soil surface may dry, inhibiting newly sprouted weeds stimulated by the watering. Constant watering which keeps the root zone saturated forces shallow rooting of the grass; should watering then cease, demise is likely. Summers in middle latitudes exhibit such a high rate of evaporation and transpiration, however, that waterlogging of the soil is most unlikely.

Most mid-continent soils are heavy, consisting of clay and silt. Their water holding capacity is much greater than with sand but water penetration is slower. Watering should be slow enough so that no run-off from the surface is wasted, and long enough so that an inch or so of water soaks in. Local sandy soils require less prolonged, but more frequent, watering.

Shallow watering with makeshift equipment is not worthwhile. It can stimulate weeds, or break grass dormancy, temporarily exhausting food reserves. Good turfgrass is accustomed to summer drought, and revives unharmed for the experience. In fact grass seems to husband its strength by turning dormant during heat and drought. The best bluegrass seed years are those with scorching summers followed by ample rain in autumn. So if you can accommodate to temporarily brown turf, this will not endanger your lawn and its attractiveness at other times of the year.

INSECTS

LAWN insect problems are fortunately few. Ants, chiggers and mosquitoes prove nuisances, but do not injure the grass.

Grubs show up in the soil from time to time, mostly of the June beetle, although sometimes similar Jap beetle larvae occur. The grubs chew off the roots just beneath the surface, causing the grass to dry out and lift like a carpet.

Sod Webworms, the larvae of lawn moths, build silken tubes nestled in the crowns of grass, and consume the tops. They are becoming more troublesome in the Midwest. Occasionally, *Chinchbugs,* small black and white insects which can be seen if shaken onto a white paper, suck juices from the grass, bleaching it into irregular patchy areas.

Fortunately these insects are all controlled by any one of several effective insecticides, chlordane, dieldrin, aldrin, heptachlor, diazinon. For soil insects and those in the crowns, it is preferable to drench the insecticide into the turf. Insecticides are not likely to burn the grass as might herbicides.

Disease. The better grasses have survived through the ages without fungicidal help, and pretty well outgrow disease. Nevertheless, for the finest sparkle, and especially with some of the named varieties subject to epidemic, fungicidal treatment may be justified.

In cool damp weather of spring, *Leafspot* may attack northern grasses. Symptoms are purplish margined splotches on the leaves, and if infection goes far enough there can be rotting at the crown and severe thinning.

Summer diseases are more prevalent on bentgrass than on other species, but some of the southern grasses may be afflicted. Identification is difficult even for the expert, so that blemishes not attributed to drought, insects, dog urination, spilled chemicals or some such cause, usually get labeled with an inconclusive name such as *Brown Patch* or *Melting Out.*

In any event, by the time a disease really shows, it is too late to do much about it. A change to drier weather normally controls the infection. Thus the best defense is preventive treatment, ahead of seasons or weather known to foster disease. The homeowner, unskilled in disease identification, would choose "general purpose" fungicides, more or less effective against a wide array of diseases. The metallic dithiocarbamates, such as Zineb and Maneb, mixtures of metals and organics (Kromad, Formula Z), mercurials (phenyl mercuries, mercuric chloride), antibiotics (Actidione-RZ), or other garden remedies (Thiram, Captan) are useful.

Summary

Lawn keeping in middle latitudes is not quite so simple as it would be either farther north or farther south, nonetheless it *is* a challenge to the gardener. Having a really good lawn reflects appreciable understanding of the turf community and its needs.

Although several years of trial and error may be required to gain experience on how best to manage your particular choice of grass, on your especial soil and location, a few simple procedures, timed well, can do much to assure success. Choose grass wisely, sow northern types in autumn, mow bluegrass–fescue high, emphasize fertilization for northern grass in autumn, treat for weeds and pests as needed. Elaborate procedures are not particularly necessary for this climate. Aerification is of value mainly for heavily trodden golf greens, or matting bermudas. There is only occasional need for rolling, and watering is optional except in time of great drought. Growth regulators, topdressings, soil amendments, microbe stimulators are all luxuries and are seldom really needed. Concentrate your main efforts upon timely seeding, proper fertilization, and intelligent mowing. A creditable lawn should then be yours, with only moderate expenditure of time and funds.

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MISSOURI BOTANICAL GARDEN

Bulletin

October 1960
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COVER: CLIMATRON AT NIGHT. One of the first photographs of the Climatron at night, with 100,000 watts of illumination, transforming it into a new landmark for St. Louis.

CONTENTS

The Climatron Opens to the Public
The First Flower of Our Dawn Redwood
Orchid Potting Media
The Pellitory Problem
Trumpet Creeper
Women's Association
Friends of the Garden
Recent Visitors to the Garden
Systematics Symposium at the Garden in October
Missouri Botanical Garden Programs

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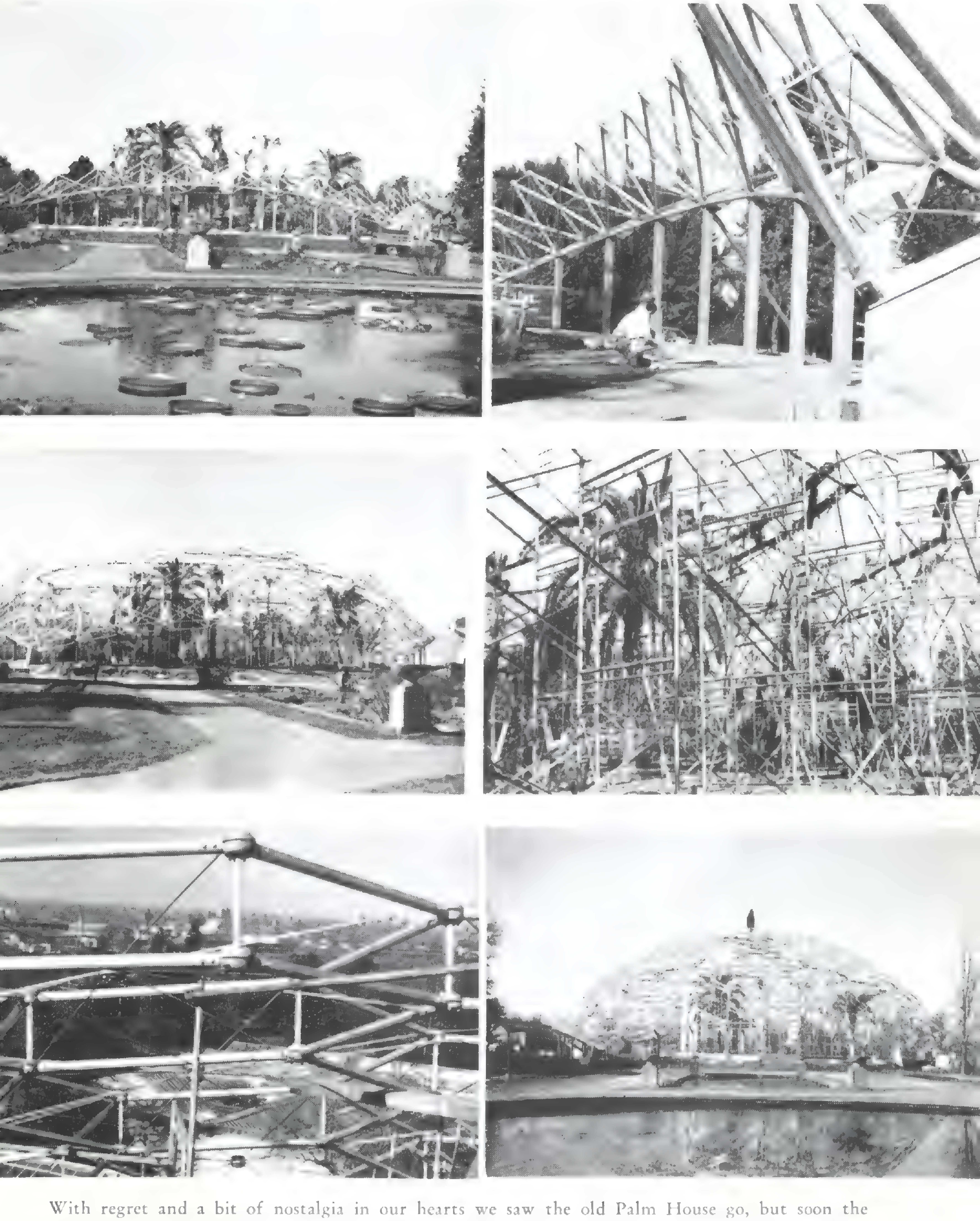
THE CLIMATRON OPENS TO THE PUBLIC

When ground was broken in the early summer of 1959 for the "new dome" conservatory, it didn't even have a name. It was only after some weeks that the name *Climatron*, coined by Dr. Went to emphasize the climate control functions of the new house, was chosen. The nameless state of the new project was perhaps somewhat symbolic of the undertaking at its beginnings.

Those early days of the Climatron *were* characterized by the uncertainty and trial and error approach that is a proper part of all pioneering. After all, we were building not just a new greenhouse for Shaw's Garden—we were inventing a radical, new kind of facility, never before even tried anywhere in the world, for a radically new approach to the growth and display of tropical plants. We were also in a roaring, tearing hurry. At the beginning, it was intended to enclose the structure with a flexible, clear plastic skin, hung like a tent from the aluminum tube framework. It was known that the framework could be erected very fast (and it was—in about six weeks) and it was hoped that the skin could be hung in a similarly short time, and that therefore the building could be enclosed before the first frost. Then came the first severe blow. No plastic manufacturer could guarantee a clear, flexible skin to stand up under sun and weather for more than a year or two. A hard decision faced the Director and the architect—go ahead with the skin, and take a chance that it would hold up, and thus protect the palms, or risk losing the palms to freezing weather in order to insure that the enclosure would be permanent. They decided that the Garden could not prudently invest in a skin that might decay in a year or two, and thus present the same problem all over again. So a new start was made on the enclosure. This resulted in the decision to use rigid plexiglass panels set in neoprene gaskets supported by the aluminum framework, that presents the Climatron as you now see it. The immediate present—and the palms—were sacrificed to the future.

Many such problems were faced and solved, many inventive minds and skilled hands gave of their best in the succeeding months to bring the great experiment to actuality. Finally on Sunday evening, October 1, 1960, with a distinguished audience of leading scientists, government officials, industrialists and many other friends of the Garden in attendance, the Climatron was dedicated to American Science, to the people of America, and especially to St. Louisans. In an impressive ceremony, the powerful lights (over 100,000 watts total) were turned on, the great dome came alive like some wonder of the future, and the doors were opened to the public.

The following pages illustrate steps in the shift from the old to the new tropical conservatory.



With regret and a bit of nostalgia in our hearts we saw the old Palm House go, but soon the same hearts swelled with pride as the traditional evergreen was set atop the new structure signifying its completion without accident.

THE FIRST FLOWER OF OUR DAWN REDWOOD

Gracefully lining the walk south of the Shaw House are nine dawn redwoods *(Metasequoia glyptostroboides)* the most recently discovered of cone-bearing genera. Until 1941 this handsome tree remained unknown to science, and then a Japanese botanist, studying some fossil remains of cypresses and redwoods, recognized some very distinct specimens to which he applied the name *Metasequoia.* These plants were first known only as fossils, survivals of a bygone era when monstrous reptiles dominated the landscape. In the same year that the fossil remains first came to be recognized and described as *Metasequoia,* a botanist in a secluded region in central China noted a peculiar tree, locally called "shui-sha," which later proved to be the dawn redwood, but it was not until 1946 that any reference to this plant was published. Only in 1948 did it become absolutely established that the "shui-sha" was a *Metasequoia,* heretofore known only as a fossil.

Botanists from all corners of the earth were excited by this startling discovery of another "living fossil," comparable in horticultural and botanical significance to the maidenhair tree *(Ginkgo biloba)*, also a native of the orient. Fortunately we are endowed with an ample collection of these two living fossils. To many people, the

designation *living fossil* is at best a vagary, and perhaps the term, so often encountered in botanical discussions, should be elucidated. In its strict sense, a fossil is defined as a trace impression or a cast of an organism from past geological ages, and evidently such a definition would exclude life from the fossil. By *living fossil* however, we mean, in the case of the maidenhair tree, the sole representative species of a once large and diverse assemblage of species, which reached their zenith when mammals were first making their appearance on the evolutionary scene, well over a hundred million years ago. Today the maidenhair tree is the only trace of that vast group of plants, and although the tree is now widely distributed, it is questionable whether or not the plant can be found growing out of cultivation, even in Japan and China, where priests first introduced it into cultivation about their temples. The dawn redwood deserves the title of living fossil on somewhat different grounds, for when this plant was first recognized, it was solely known from fossils, and the living representatives were only later to be discovered. This year at Shaw's Garden for the first time we have flowers on a tree that less than twenty years ago was presumed to be extinct, a timely reminder that the frontiers of botany are far from exhausted.

After the revolutionary discovery of the living dawn redwood, Dr. E. D. Merrill, with the aid of a grant from the Arnold Arboretum and the able cooperation of some Chinese biologists, succeeded in importing numerous seeds to this country. Between 1947 and 1948 these were disseminated to the more important botanical gardens of many nations. Our seeds were received from Dr. Merrill in one of the initial shipments, and today, after only twelve years, our trees, some nearly thirty feet tall, are quite majestic, and certainly give reason for the widespread popularity that has become affixed to this, one of the most rapidly growing conifers. Now the tree has worldwide distribution, just as the maidenhair tree, and it is proving to be quite as popular in horticultural circles. The dawn redwood grows even more rapidly than our bald cypress (*Taxodium distichum*), and assumes, under most circumstances, a stately conical shape. The leaves are deciduous as in the bald cypress, in contrast to most conifer leaves, and form graceful verdant sprays, flattened as those of the arbor vitae. The dawn

Young female cones of the *Metasequoia*

redwood and the bald cypress share the peculiarity of shedding the entire spray, which is a branchlet with several leaves, rather than the individual leaves, as in most deciduous trees.

By 1958 flowers had been reported on a few trees scattered over the country. In all cases however, the trees, which at maturity are supposed to bear both male and female flowers, were reported to bear only female flowers. In late April of this year I first noticed the young and unopened female flowers on some of our dawn redwoods, but I too was unable to locate any male flowers. At the present writing in the dog days of August, the female flowers are only about twice as large as they were in spring. These flowers, usually called cones by botanists, are borne singly toward the end of some of the branches. The top-shaped cones have a blue-gray cast, reminiscent of the waxy coating of a cedar "berry." Each cone consists of several drastically modified leaves called bracts, which little resemble the foliage leaves. On the upper surface of each bract are borne about eight ovules. In early May these bracts are fleshy and so closely overlapping that it seems rather improbable that pollen could sift through to ultimately fertilize the ovules, even if there were male cones around to furnish the pollen. Presumably, elongation of the cone axis would separate the bracts sufficiently to allow the passage of the wind and the pollen it bears. But this year, here and probably elsewhere in the United States, there was no pollen of the dawn redwood in the breeze, for male cones remain unreported in America. Consequently there will be no seed harvest this year, for the ovules remain unfertilized. It is fortunate indeed that the tree can be propagated by cuttings. We have met with moderate success in establishing cuttings, but under rather exacting conditions. Perhaps in a year or so, our trees will bear male flowers for the first time, and we will witness the first seed production of the dawn redwood at Shaw's Garden.

A short stroll due south of the Shaw House will reveal the full beauty of the tree before it sheds its branchlets for winter. On leaving the Shaw House, the walk goes through a lane of dawn redwoods and then ends at the bases of a staunch pair of bald cypresses. But don't fall victim to the fallacy which befell me when I first saw the dawn redwood; I mistook it for a cypress. If you compare the two for yourself however, you will always know the difference between two of our most beautiful conifers.

JIM DUKE

ORCHID POTTING MEDIA

THE Missouri Botanical Garden in 1928 began a series of extensive experiments under the direction of Dr. David Fairburn on orchid hydroponics (soilless plant culture). These studies have added greatly to our knowledge of orchid culture and it would seem beneficial at this time to review this work in an effort to help clarify the present confusion concerning orchid potting media.*

One of the most important conclusions that may be drawn from the Garden's hydroponics work is that orchids can be grown well in almost any medium provided that all the factors essential to growth and development are present and in proper proportions to each other. What these essential factors are and how they can best be supplied to an epiphytic orchid may be more readily understood by describing a hypothetically perfect potting medium for these plants.

Characteristics of an Ideal Orchid Potting Medium

An ideal orchid potting medium would have the following features:

1. Open, well drained physical structure.
2. Acid, pH from 5 to 6.
3. Nutrients of proper type and amount to support plant growth for an indeterminate period.
4. Resistance to decay and physical decomposition.
5. Buffering qualities to prevent rapid fluctuations in salt concentration and pH.
6. Obtainable at moderate price and in adequate quantities.
7. Easy to manipulate and requiring little skill or training to use.
8. Free of toxic elements.

During the past fifty years the Missouri Botanical Garden has used three different types of potting media: osmunda (fern root), gravel (or haydite) and fir bark. In the following chart each of these materials is compared with the hypothetically ideal potting medium.

As the chart indicates, none of the listed materials have all of the features which an an orchidologist would desire in an ideal potting medium. The osmunda is expensive, and difficult to use. Furthermore, an orchid potter can pot four plants in fir bark or gravel in the same time it would take to pot one plant in osmunda. Gravel (torpedo grade) has proven to be an excellent potting medium. Its deficiencies are lack of nutrients, no buffering qualities and excessive weight. Plants potted in gravel weigh approximately twice what similar sized plants weigh in fir bark. Fir bark is also lacking in nutrients and, of course, is more expensive than gravel.

Comparison Chart

Desired Qualities	*Osmunda*	*Gravel*	*Fir Bark*
Water drainage	Early stages—good later stages—poor	Very good	Course grades good
Acidity	pH 5	Usually neutral	pH 4–5 changes little
Nutrients	Sufficient for 18 to 24 months	None	Very little
Decomposition	Varies with type, 18–24 months	None	Varies with type, 1–3 years
Buffering qualities	Good	Very little	Moderate
Cost	Expensive	Very cheap	Moderate
Toxic elements	None	None	None

CONSTANT LEVEL FEEDING

Originally the deficiencies in fir bark were overcome by adding organic fertilizers which release small amounts of soluble nutrients over a long period of time. Periodic applications of an inorganic water soluble fertilizer were also made. More recently the Garden has changed its fertilizer program to a constant level-micro nutrient system. Under this method a complete water soluble liquid fertilizer is injected into the water line so as to produce a 1 to 2 parts per million concentration each of nitrogen, potassium and phosphorus in the water being applied to the plants. This fertilizer level is constant and present whenever water is used. The constant level-micro nutrient feeding program overcomes two of the basic faults found in the previous fertilizing system. It eliminates the guesswork that is inherent in the use of all organic fertilizers. Organics are in a constant state of decomposition and it is impossible to estimate exactly how much soluble nutrients they are releasing for plant use and exactly when they are available or when they have decomposed to a point where they are no longer useful. Under the constant level-micro nutrient program, a grower knows that every time water is applied to a plant, the plant has available a certain predetermined concentration of fertilizer. The previous systems of fertilizing called for a monthly or semi-monthly application of nutrients. These solutions were relatively high concentrations and completely water soluble. Under this program the plants received periodically a heavy dose of highly concentrated fertilizer which was soon leached from the potting medium by subsequent nutrient-free waterings. Horticulturists realize that plants do not take up nutrients in periodic large doses, but rather they supply their nutritional needs by taking up small quantities continuously, much as the human body takes a series of small but complete meals each day.

POTTING MEDIUM EXPERIMENT

The orchid department in April 1959, at the suggestion of Dr. Frits W. Went, set up an experiment to test several types of orchid potting media. A block of hybrid white Cattleyas (Mrs. John S. Lehmann) was divided into 4 groups of 50 plants each. Group I was potted in a standard fir bark mix containing organic and inorganic fertilizer additives. This is the Garden's standard potting mixture (see M.B.G. BULLETIN No. 2 Feb. 1959). Group II was potted in straight fir bark as it came from the bag. Group III was potted in a mixture of ½ fir bark and ½ torpedo gravel, and Group IV was potted in pure torpedo gravel. Groups II, III and IV were fed twice a week with a water soluble fertilizer solution (Earhart Lab. fertilizer solution, see Went, "Experimental Control of Plant Growth" pp 78–79). Group I was given a monthly application of the same fertilizer. These plants have now been receiving the described treatments for 18 months and none of the groups show any distinguishing differences in vigor, root growth, or flower qualities. The plants in pure torpedo gravel are as vigorous and as floriferous as any of the other groups.

Cattleya elongata showing increase in bulb size on current growth.

Cattleya Mrs. John S. Lehmann illustrating extensive root system developed while growing in gravel.

The remainder of the Garden's orchid collection has been receiving the constant level-micro nutrient feeding program for about five months. As a whole the collection seems to be in excellent cultural condition. Whether the new fertilizing program is responsible for this improvement is speculative as many other factors must be considered. It will take from one to two years before this new fertilizing program can be completely and finally evaluated. The illustration of a plant *Cattleya elongata* demonstrates how some of the plants in the collection have been stepped-up in bulb growth and vigor in the past growing season. The second illustration shows similarly how root growth has been stimulated.

R. J. G.

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[*]Vol. XL No. 6 (June 1952) of the MISSOURI BOTANICAL GARDEN BULLETIN is devoted to this work. This issue of the BULLETIN is out of print, but copies are usually available at most biology libraries.

THE PELLITORY PROBLEM

When I moved into the Cleveland Avenue gatehouse in 1952, there was a gracefully branched little plant that I did not know in one of the flower beds, though I had a vague memory of having seen it before in wooded areas. When it came up luxuriantly the following spring, I let it stay, thinking it might be of some ornamental value. By early summer it was a little over a foot high. Tiny greenish flowers, clustered at the base of the leaves, gave it such a weedy look that I pulled it all up and threw it on the compost heap. Ever since that time it has been one of the commonest weeds in my garden, though not until recently did I get around to finding out what it was.

It proves to be a pellitory, *Parietaria pensylvanica,* a common plant in wooded and rocky places from Maine to Florida, westwards to Minnesota and Texas. The scientific name (*paries* being Latin for wall) comes from the ancient Latin name for the pellitory of Europe which is frequently found growing on old walls. Though there are no previous reports of *Parietaria pensylvanica* growing as a wall plant it does indeed do so at the Missouri Botanical Garden, not only at the base of Henry Shaw's old wall along Tower Grove Avenue but there are even little tufts in crevices between some of the stones.

If one is to have a weed in the garden, there couldn't be a nicer one. It is a graceful plant, seldom over a foot high and though when mature it can branch out into quite a bush, it is never at all rampant. It is not hard to destroy, once one has seen it, but it has a characteristic way of getting started down behind other plants and not showing up until it is pretty well grown. I know of no weed which is easier to pull up. The delicate little stems are tough and fibrous; if one pulls gently but firmly he nearly always gets the entire plant, roots and all. Frequently this will include several other branches in addition to the ones which the eye had already spotted. The leaves and stem seem almost to cling to the fingers. Under the microscope it is readily seen that they are clothed in tiny little greenish-white hairs which are hooked. They are just strong enough so that one can demonstrate their presence by pulling off a leaf and pressing its lower side against his clothing, where it will remain until it is pulled off, coming loose with a sharp little tearing noise as hundreds of tiny hooks release their hold. It clings just enough to be interesting, not enough to be a nuisance.

All in all it is a gentle little plant, as weeds go, and not at all ugly or coarse. Yet it is a heavy seeder and it does persist, particularly in a garden of perennials. One can pull out every plant of pellitory in sight and ten days later a whole new crop will have come up through the violets or out from under the barberry hedge.

Having made the official acquaintance of *Parietaria pensylvanica* (the pensylvanica, with one *n*, is correct, since it was so spelled by Gotthilf Henry Ernest Muhlenberg who first named the species), I looked it up in various floras and manuals and in the herbarium, revealing thereby that there is a pellitory problem. Not every one of the several score specimens in the herbarium is accompanied by any information but a majority of them are so annotated and on not a one is there any indication of pellitory as a weed. "In rocky woods," "at the base of a cliff," "in low sandy woods" are the commonest remarks, though it is reported from a sand bar in Texas and from a gravelly beach in Maine.

The floras and manuals tell the same story. Steyermark, in his Spring Flora of Missouri, says it is found throughout the state in "Open or rocky woods, bluffs, thickets, glades, and moist open ground." It is not listed in the U.S.D.A. publication, Weeds of the Central States. Shinners in his Spring Flora of the Dallas Region, worked out meticulously the way in which *Parietaria pensylvanica* grades into the hairer *P. pensylvanica obtusa*, but does not list it as a weed. The late C. C. Deam took a special interest in weeds and I turned to his Flora of Indiana expectantly but found no mention of weedy pellitories.

One likely hypothesis might be that a special weedy strain has just recently been spreading into this area. This may be so, but careful study in the herbarium produced no evidence for such an hypothesis. I pulled up a good selection of pellitories from my garden and examined them under the microscope for such technical details as the proportionate length of the bracts, the frequency and kinds of hairs on stems and leaves, the shapes and sizes of the leaves. If they do indeed belong to a weedy race which is just beginning to appear in this area, they bear no outward sign of it, that I could find.

From Hugh Cutler, I learned that he had made the acquaintance of the pellitory when he lived on Shaw Place. He knew how common it was becoming in this part of St. Louis and had learned that it was not listed as a weed. The mystery remains. Has our American pellitory been weedy for years but its weediness ignored by botanists? Is it as weedy elsewhere as in this part of St. Louis? Has it been common even here for a long time without our noticing it? Or are Hugh Cutler and I correct in guessing that a weedy strain of pellitory has recently come into St. Louis gardens? E. A.

TRUMPET CREEPER

SEVERAL years ago a specimen of the beautiful trumpet creeper, *Mme. Galen*, was planted at the base of a gatepost in the rear of Mr. Shaw's old country residence, *Tower Grove*. This year it has been in full flower throughout July and August and has attracted much attention. This variety, the most beautiful of all the trumpet creepers, is a descendant of a hybrid between the common American trumpet creeper and the Chinese species. It combines the best features of both species, being somewhat less weedy than the American, yet with more winter hardiness than the Chinese. Compared with our American trumpet creeper it has larger, more open flowers, in more graceful, open clusters. In color it is a brighter and yet more delicate blend of red and orange shades. It is indeed a handsome plant and we are happy to have a good specimen of it. E. A.

WOMEN'S ASSOCIATION

MEMBERS of the Garden's Women's Association have raised more than $19,000 during the past year for the Second Century Expansion and Redevelopment Program of Shaw's Garden.

Mrs. W. Warren Kirkbride, President of the Association, acknowledged in announcing the contribution, the devoted support of Garden Clubs and Friends of the Garden members in the St. Louis area. With their help, two large public benefits were staged: During the nine-day centennial festival last fall the women opened sales booths offering a wide variety of garden supplies, "white elephants," plant materials and other items of interest to garden lovers. In the spring, through the cooperation of Famous-Barr Company, a plant and garden supply sale called "Through the Garden Gate," was held in a gaily decorated part of Famous-Barr's Clayton store parking lot. A sidewalk cafe featuring herb dishes, a garden advice booth, a "touch of elegance" booth and many others made "Through the Garden Gate" so popular that it sold out well ahead of schedule.

During the winter brightly decorated tiny hats were mailed to nearly 200 Women's Association members with a poem suggesting it was time to "Pass the Hat." This private solicitation brought the total funds realized from the Association's activities to well over $19,000.

Plans are now being completed for the second annual "Through the Garden Gate" event next May. Mrs. Bert A. Lynch, Jr., and Mrs. Arthur Feuerbacher are co-chairmen, and the St. Louis Herb Society will participate in next spring's activity, making the herb booth one of the outstanding features.

Checks representing more than $19,000, raised during the past year by the Women's Association of the Missouri Botanical (Shaw's) Garden, are presented by association president, Mrs. W. Warren Kirkbride, to Dr. Frits W. Went, Director. Funds earmarked for the Garden's improvement program came from sales activities during the Garden's centennial celebration last autumn and other benefits during the year.

FRIENDS OF THE GARDEN

An executive board for Friends of the Garden was appointed during the summer by Robert Brookings Smith, president of the Garden's trustees, who named John R. Averill and Mrs. William R. Bascom, president and vice-president respectively of the Friends organization.

Harry W. Wuertenbaecher, Jr., is committee chairman for membership activities, with Mrs. Curtis Ford and William W. Spivy as vice-chairmen for membership. The new executive board is now completing plans for a "personal touch" campaign to increase Friends' membership early in the fall.

This is the first time a formal executive board has existed for the 20-year-old Friends group. In addition to the membership project, the new board will sponsor various organizational activities and seek ways to increase public awareness of and interest in Shaw's Garden, Averill announced.

Other members of the new board are: Mrs. Henry Belz, George H. Capps, Mrs. John R. Caulk, Jr., Mrs. Rhodes E. Cave, E. R. Culver, III, Mrs. Con P. Curran, Mrs. Dudley F. Giberson, Miss Elizabeth Golterman, George T. Guernsey, III, Mrs. W. Warren Kirkbride, Edward L. Kuhs, Mr. and Mrs. Sears Lehmann, Jr., Benjamin M. Loeb, James H. Lum, Mrs. Bert A. Lynch, John Peters MacCarthy, Mrs. James S. McDonnell, Mrs. Carl F. G. Meyer, Mrs. Edward A. Reisse, Mrs. Gilbert J. Samuelson, Mrs. Edward F. Schweich, Mrs. James A. Seddon, Jacob Van Dyke and Mrs. Felix N. Williams.

Three new members of the Friends of the Garden executive board met at the Garden in August to make plans for increasing membership. Shown here are Harry Wuertenbaecher, Jr., (right) chairman for membership, Mrs. Curtis Ford and William W. Spivy, vice-chairmen for membership.

RECENT VISITORS TO THE GARDEN

Sir Harold Caccia, British Ambassador to the United States, (center) is greeted at the Shaw's House entrance during his visit to St. Louis in June. Robert Brookings Smith, Garden board chairman, (right) and Dr. Frits W. Went, Director, gave Sir Harold a tour of the Garden after which the Historical Committee entertained him at a reception in the Shaw House. Sir Harold recalled Henry Shaw's English origin and the close ties he maintained with friends at the Royal Botanic Gardens at Kew who supplied Shaw with aid and encouragement when he set out to establish a Botanical Garden in St. Louis.

In the back parlor of the Henry Shaw Country House Mrs. Richard M. Nixon in honor of her twentieth wedding anniversary has just been presented with an orchid by Mrs. Edwin R. Culver, Jr., of the Garden's Historical Committee, and Leicester B. Faust, First Vice President of the Board of Trustees. A cluster of press and television men filled the room which was ablaze with spotlights and flash bulbs.

SYSTEMATICS SYMPOSIUM AT THE GARDEN IN OCTOBER

The Seventh Annual Symposium on Systematics will be held at the Garden on the 14th and 15th of October. The title of this year's symposium is to be "Tools of Taxonomy." The Symposium, held annually in October for the past six years, is supported by a grant from the National Science Foundation. About 200 biologists and students are expected to attend, largely from the central United States. There will be a smoker and registration on Friday, from 7:00 to 10:00 P. M., and the symposium proper will be held on Saturday. Dr. E. Raymond Hall, of the University of Kansas, will be the Zoology Chairman, and Dr. Robert E. Woodson will be the Botany Chairman. The speakers will be Dr. Robert T. Hatt, Cranbrook Institute of Science; Mr. Paul C. Hutchison, University of California Botanical Garden; Dr. A. C. Smith, U. S. National Museum; Dr. Frits W. Went, Missouri Botanical Garden; and Dr. Marshall R. Wheeler, University of Texas.

For further information contact Dr. Robert L. Dressler, Missouri Botanical Garden.

MISSOURI BOTANICAL GARDEN PROGRAMS

Special Shows and Displays:
Midwestern Regional Budgie Show, October 7, 8, and 9.

Systematics Symposium, October 15 and 16.

Chrysanthemum Show, November 6 through December 4.

Free Nature Programs for Children, aged seven and over, are held every Saturday morning from 10:00 to 11:30 A. M. in the Museum Building. Program for October and November:

From Dust to Seeds	October 1
Fall's Carnival	8
Fall's Frolic	15
Planting Bulbs (you may take your bulbs home)	22
Witch's Brew	29
Color Sound Movies	November 5
The Rise of Forests	12
Woodlands of America I	19
Woodlands of America II	26

COURSES

The following courses are open to any interested person. Certificates are awarded upon the successful completion of any course.

Information on registration may be obtained by calling

PRospect 6-5567

Please send all registration fees to

Missouri Botanical Garden
2315 Tower Grove Avenue
St. Louis 10, Missouri

Registration fees cannot be refunded after the last day of registration for any particular course.

The courses will meet in the classroom of the Garden's Museum Building.

COURSE 107

Botany for Home Gardeners

Place: Museum Bldg.

Time: Five Monday nights, 7:30 to 9:30 P. M. Starting November 14.

Fee: $15 for the five sessions.

The course emphasizes basic structure of both herbaceous and woody plants, the nature of changes which adapt plant parts to particular situations, seed structure and germination of both monocotyledonous and dicotyledonous plants and familiarization with chromosomes, cell division and sex cell formation. The course will be taught as a laboratory-discussion, and will be built around fundamental observations essential to intelligent understanding and growing of plants. No previous knowledge of plants is required.

Open to all persons of any age seriously interested in plants.

Instructor: Dr. Norton H. Nickerson.

COURSE 127

Bulb Forcing

Place: Museum Bldg.

Time: (Register for only ONE of the sections offered.)

Tuesday, October 11, 7:00 to 9:30 P. M.

Thursday, October 13, 9:00 to 11:30 A. M.

Friday, October 14, 1:00 to 3:30 P. M.

Tuesday, October 18, 9:00 to 11:30 A. M.

Wednesday, October 19, 1:00 to 3:30 P. M.

Fee: $8 for one meeting.

Enrollment: Each section is limited to 25 students.

The meeting will consist of a short lecture followed by a student practice session.

The lecturer will give instructions on bulb forcing and outdoor bulb culture. During the practice session, each student will plant at least 24 top quality bulbs (tulips, narcissi, paperwhites and hyacinths) in five 7-inch bulb pans. All materials are provided by the Garden. The planted bulbs will be kept under cold treatment in the Garden bulb pit and greenhouses until ready to flower (60–80 days). Each student will be notified when to call for his or her bulbs. This course is intended primarily for beginners.

Instructors: Mr. Clarence Barbre, Mr. Kenneth Peck.

COURSE 128

Modern Horticulture for Home Gardeners II

Place: Museum Bldg.

Time: Five Tuesday nights, 7:30 to 9:30 P. M. Starting November 1.

Fee: $15 for the five meetings.

Complements Course 123 but may be taken independently. Subject matter includes background knowledge essential to really successful growing of many types of plants. An orderly survey of environmental factors which affect plant growth and how the home gardener can manipulate these factors to achieve good growing results. Soil testing and what to do to improve soil conditions found on your property, plant propagation and plant diseases will be included. Each evening will feature both practical and classroom work. Students may take home plant material at end of each meeting.

Instructor: Mr. Robert J. Gillespie.

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AN IMPORTANT MESSAGE TO

Friends of the Garden

Major financial support for the Garden's Second Century Redevelopment Program depends in part upon tripling membership in the Friends, as evidence of community interest. If this is accomplished, the Redevelopment Program can move ahead without delay. Thus each new member has greatly added importance at this time and the Friends have a unique opportunity to provide the most significant help to the Garden in its long history.

If every Friend of the Garden would find one additional member, the 1960-61 membership goal of 7,500 Friends could be more than three fourths met and very substantial funds gained for Shaw's Garden.

—

BE A FRIEND AND BRING A FRIEND

—

Membership is $10 and up.

For information and membership blanks call or write

Friends of the Garden
PRospect 6-5567
2315 Tower Grove Avenue
St. Louis 10, Missouri

MISSOURI BOTANICAL GARDEN
Bulletin

November 1960
Volume XLVIII
Number 9

Imai-no-hanagaki

Cover: Imai-no-hanagaki. A beautiful old Japanese variety of Chrysanthemum, white and red in color. Drawing from Kikkwa-Meijisen, Tokyo, Japan, December 1891. The prefix "Imai" denotes the originator of the variety.

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CONTENTS

How Nature Prepares for Winter
An Executive's Garden
Pink Maids
Groundsel Tree - Salt Bush
Summer Nature Programs at the Garden
Flower Shows
Missouri Botanical Garden Programs

◆

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HOW NATURE PREPARES FOR WINTER

F. W. WENT

NATURE, in preparing herself for winter, seems to be guilty of an enormous waste in the form of great masses of discarded leaves, the dying of above-ground parts of perennials, and the wholesale death of annual plants. Yet this waste is inevitable since, in most plants, the leaves are so sensitive to adverse winter conditions that they could not survive. However, if we consider the autumnal leaf fall from all angles, it does not turn out to be so wasteful as it seems at first glance. It might even be said that it is a blessing in disguise.

An annual plant dies in less than a year after it germinates, but only after it has finished its life cycle. After having produced seeds, through which the species can continue, it has fulfilled its mission, and even if by some chance the mother plant survived the winter, it would not produce more, or earlier, seed than seedlings germinating next spring. In these annuals, the effort to produce seed is usually so great that not only all food produced in previous months is used up, but also the substance of the stem and leaves is drained from them. Thus they wither prior to complete seed maturity.

FOOD DRAINAGE

You can observe in the agave and in many kinds of yucca, clear examples of such complete drainage of all living substance from the leaves and trunk. While the plant is still flowering, the leaves start to shrivel, and this shrivelling, which indicates progressive emptying of the leaf cells, continues until at seed maturity the rest of the plant is dead. All life has flowed towards the seed. Corn stems and leaves contain much excess food, before the seeds have matured. When these are harvested they can be silaged, producing excellent cattle fodder. But once the seeds have matured, very little food is left in stem and leaves.

In perennial plants and deciduous trees, the plant seldom flowers or fruits itself to death. The leaves usually stay on for some time after maturity of the fruit. This is essential for survival of the plant. The fruit production of a cherry, peach, or plum often takes most of the strength from the tree, and the spent storage food has to be replenished. This is accomplished during a few months of intensive photosynthesis after the fruit has become ripe.

FOOD STORAGE

But this is not all. Just prior to the turning of the color in leaves of deciduous trees, they start to mobilize their most important constituents. By the time the leaves drop, they are not much more than empty containers. Attached to the tree they were active factories, provided with all machinery necessary to produce food and other essential chemicals. They also had some storage space, where the manufactured products could be kept until they were transferred to more permanent storage. In autumn, the most valuable components, which could not easily be replaced, are moved out of the leaves to branches and trunk. They are then available when new factories have to be installed next spring, when new leaves develop. The most valuable parts are nitrogen-containing compounds (especially proteins), potassium, and phosphorus. These are moved out of the leaves, and this causes the well-known change in color. The green chlorophyll, containing nitrogen, is decomposed, so that only the yellow and orange carotenes are left, and the leaves turn yellow. The sugars and starch are moved out of the leaves. What is left are, mainly, the cellulose of the cell walls, some calcium, the yellow carotenes, and some other materials which are either too hard to move, or which are not very essential.

The dry leaves which drop off in the first autumn winds, after turning color, are really empty shells. This is also indicated by the fact that they decompose very slowly. If they were full of proteins and sugars, such as green leaves are, bacteria would feast upon them, and they would rot rapidly on the moist ground. Fresh leaves, such as grass clippings, put in a compost or leaf mold pile, disintegrate rapidly. But the dead autumn leaves take much longer to decompose. When they are mixed with fresh manure and other materials nutritious to bacteria, they rot more rapidy, but left to themselves nothing much happens. They have become inert. The removal of nitrogen, potassium, and phosphorus from older leaves also occurs in annual plants, but only when there is a deficiency of these nutrients in the soil. A plant starving for nitrogen will have its buds and young leaves grow at the expense of the nitrogen in the older leaves, which is moved out. This causes the older leaves to turn yellow and drop off. But in case of a calcium deficiency, the older leaves do not turn yellow and die, because calcium cannot be removed from older leaves. This is also true in the autumn drop of leaves. They fall off still retaining their full content of calcium.

During the Indian summer in the east, but also to some extent during the Fall in the west, leaves of sumac, Virginia creeper, and sweet gum turn a brilliant red or purple. This color is due to the formation of a pigment, anthocyanin, which usually is produced in cells full of sugar. The reddening of the leaves is an indication that their sugar content has gone up. This increase in sugar is usually due to transformation of starch into sugar. The insoluble starch cannot be moved as such. It first has to be changed to sugars which are easily soluble and can thus flow out of the leaves. Formation of sugar from starch occurs rapidly when the temperature drops to near freezing. Therefore, the red colors of the Indian summer flare up after the first cold nights. The cold is the signal, for trees and shrubs, that winter is approaching, warning them to start emptying their leaves before it becomes too cold. They rapidly dissolve their starch, and the resulting high sugar content causes the formation of the red and purple anthocyanins.

COLORS

This effect of cold on red pigment formation explains why the red autumn colors in the east are so intensive while in Pacific Coast regions they are seldom of the same intensity. Plants there, are very rarely exposed to near-freezing temperatures before they have lost their leaves. Autumn colors there, are of the rich golden and yellow types, due to the loss of chlorophyll which normally masks the yellow carotenes.

This also teaches us a lesson about pruning the older leaves of a healthy plant. During the life span of a leaf, there first comes a period when it is growing rapidly and is using much more food than it can make. The second period is the longest. During that time, the leaf's chemical factory is working full blast, and it provides the rest of the plant with food and hormones. The last period sets in as the color begins to change. The factory is dismantled, storerooms are emptied, and all is moved toward the branch. The amount of food and material which becomes available in this way may equal weeks of activity of the leaf in its second period. Therefore, cutting leaves off just because their color is not lush green any more may deprive the plant of huge supplies just ready to be shipped. Usually the leaf drops off by itself at the proper time, through the aid of a very neat mechanism.

Where the leafstalk joins the stem or branch, there exists a layer of cells which are inactive so long as the leaf is active. The activity of the leaf is registered on these cells by the auxin, or plant-growth hormone, which is formed by the leaf. As soon as the flow of auxin stops, this layer of cells becomes active. The cells separate from each other, and in a few days, this layer has become so weak that the leaf, plus leaf stalk, breaks off at a slight touch or a breath of wind. As a leaf grows older, it forms less and less auxin. A leaf, after turning yellow, produces no more auxin, and therefore the leaf drops a few days after it has changed color.

* * *

AN EXECUTIVE'S GARDEN

KENNETH O. PECK

In the rural areas surrounding a metropolis of any size, the inevitable succession of events can be briefly expressed as forest and prairie giving way to carefully staked out, asphalt-lined subdivisions and shopping centers. The inhabitants of these vast, treeless expanses of real estate, sensing some sort of void, are curiously turned to enhance their new environments by planting trees, shrubs, and geraniums or petunias — that is, if their new homes are not already equipped with silver maples or Chinese elms, and Pfitzer junipers.

The art of gardening, among others, can certainly be placed among the earlier "do-it-yourself" activities which, in the present day, seem to have taken a fairly firm stranglehold on the nation's economy and way of life.

If a person wants a little garden in these times, all he has to do is go to his favorite supermarket, garden shop, hardware, dime, drug or department store, to purchase a plastic-wrapped, seed-imbedded mat which he can lay on a previously scratched patch of ground, either side up. When properly watered, this procedure will give the semblance of a flower border. Or he can take one primitive step backward and buy a plastic box in which seeds have already been sown. He then punches holes in the plastic top and adds water. The depressions are to tell him where to punch the holes. The primitive feature of this method is that the gardener should transplant the resulting seedings to his garden.

Aside from being an art, gardening should be a pleasure but there are many considerations that seem to discourage people from enjoying this pastime. Among these are contemplations of having to keep flower beds and borders weeded, watered, sprayed and fertilized; the ferreting out of the several products from the many marketed, all of which claim to give the consumer an award-winning garden if used according to directions, and which are best suited to help the gardener to have the best-looking, most vigorous, "varmint-free" border on the block. This is not all. Conflicting free advice from neighbors, friends and other people who are supposed to know, is often quite enough to discourage anyone aspiring to have a green thumb. Here is an excellent instance in which a botanical garden, through its courses in all phases of horticulture, can be of great assistance.

Limited time often prevents some people from having a garden. There are many who say, "I really would like to have a garden, but I just don't have the time". For these people, if they are sincere, there is a type of garden that requires amazingly little time to maintain. In fact, once established, this little garden requires little more than water and gives in return the rewarding pleasure of just looking at it. The kind of gardening to which I refer is a form of rock gardening on a small scale, that is, gardening in a sink. This is by no means an innovation. I have used an old soapstone laundry sink given to me by a neighbor who, because of the marvel of the automatic washer, was delighted to get rid of the thing. It measures 24″ x 48″ x 15″ deep.

It is hoped that this article about sink type gardens will appeal to our readers. I would not attempt to mislead anyone by saying that setting up a sink garden is an easy task. Moving that 360 pound sink into place from my neighbor's basement was somewhat akin to playing tiddywinks with manhole covers. One need not use a laundry sink. Natural stone troughs or sinks would be ideal. Or, it is not difficult to make one of concrete.

Since many of the plants that are suitable for the sink cannot be easily purchased, the plants are more simply obtained from seed. Most of the plants mentioned herein have been grown from seed by the writer since January, 1960. In accordance with directions given in several rock gardening books, all seeds were sown in flats on a mixture of equal parts of soil, sand, peat and fine gravel. The seeded flats were placed in a coldframe and watered alternately with tepid water and snow. The results were not as rewarding as would have been desirable, but at least ten of the varieties that did not germinate were those known to give trouble. In the light of the difficulty encountered, I would recommend sowing seeds on a sterile medium such as milled Sphagnum moss in separate, shallow clay or plastic pots 4 to 7 inches in diameter.

Minature garden in an old soapstone sink.

Seeds of certain genera require exposure to alternate freezing and thawing temperatures in order to break dormancy, dictating the time of seed sowing which should be observed between mid-December and early February. Some seeds in this category are: *Achillea, Androsace, Cotyledon, Draba, Gentiana, Globularia, Lewisia, Nemastylis, Primula, Saxifragra,* and certain species of *Alyssum* and *Penstemon.*

Seeds of the following may also be sown outside but also germinate freely inside during February without exposure to low temperatures: *Armeria, Calandrina, Campanula, Carlina, Dianthus, Erigeron, Geum, Gypsophila, Lychnis, Platycodon, Silene* and *Veronica.* The seedlings, of course must later be transplanted to other flats of soil. In mid-April, they can be moved to a cold frame or to a sunny, frost-free, protected place. I used a hastily but serviceably-constructed plastic greenhouse which was by no means airtight, but which offered protection from late frosts and allowed placement of plants in full sun.

In early April, or even in the last part of March, the seeds in the cold frame should be starting to germinate. Germination of the various species will not occur simultaneously, some beginning in March or April, while others will not start until early May. When these seedlings are large enough to handle, they must be transplanted to flats, three inches or more deep, in which they may be kept for several months if freely spaced.

At this point there are several matters to consider about the new plants. First one should be sure that enough individuals — 12 to 15 or more — of each species are kept growing. Secondly a nursery should be planned if it is desired to grow many plants. A plant growing area would be best placed on the east or north side of a building. Whether or not the young plants are kept in flats or are placed in a nursery, the young seedlings must be protected from heavy rains until they have attained a fair size. In any case, provisions for an exceedingly well drained soil must be made. This can be accomplished by mixing equal parts of friable soil, sand, gravel and brown, granulated peat or well-rotted leaf mould.

Gypsophylla repens (left) *Silene alpestris* (right) *Sedum sp.* (upper right). Note neat appearance of gravel mulch.

In selecting a site for the sink, be sure it is a place that receives no more than 4 to 5 hours direct sunlight, preferably before midday. Through the remainder of the day, shade cast by trees or buildings is important, but in no case should the sink be placed entirely in shade under a tree. One should also realize that after its location has been decided upon the sink cannot be moved.

It would be well to set the sink on a mound of flat stones or concrete blocks so that it is level and the top of it is approximately knee-high, or scarcely more than at a toddler's eye-view. If it does not already have one, a drainage hole must be made in the bottom of the sink since standing water in the bottom will become foul if there is no way to change it frequently or constantly, as in the case of the moraine garden.

The sink should be filled with soil well in advance of planting by at least one month. During this time, the fill will settle and additional soil may be added before planting to compensate for settling. The soil level should be within one-half inch of the top. Use small rocks and concrete rubble to fill the first one-third to one-half of the sink, followed by a layer of coarse gravel, a layer of fine gravel, then the recommended soil mixture. After filling, there should be at least 6 to 8 inches of soil for root penetration.

When planting the sink, take the habit of each plant into consideration. Taller plants should be placed in the rear, trailing plants, perhaps near the edge, tufted plants placed to please the individual. One might wonder how it would be possible to grow a suitable number of plants in an area just under 8 square feet, but if the right kinds of plants are used, such an area will accommodate more than two dozen individuals.

It has been said that much of the hardiness of a successfully grown plant in the St. Louis area consists of its ability to withstand cold as well as to tolerate our excessive summer heat. Water, except for conditions of extreme drought or abundance, should never be a problem as long as soil and exposure conditions are ideal. With these thoughts in mind, a description of some of the delightful plants that can be expected to fare well both summer and winter follows. Most of these are easily grown from seed and require no pampering.

Achillea "Little Beauty" — Yarrow. This little composite forms low mats of silvery-wooly, dissected foliage topped by 6-inch sprays of yellow flowers. "Little Beauty" will tolerate partial shade but makes its best showing in full sun. It stays under 2 inches but may cover an area 8 to 10 inches across in one season from seed.

Aster kumleini (also *A. oblongifolius)* is a native from the Dakotas and Montana with blue-purple or pink flowers. Perhaps its 12 inch height might render it a bit tall for the sink garden, but its basal rosettes send up one to several bushy, flower-covered stalks that are really quite beautiful. About one out of ten plants bloom the first year.

Campanula—Bellflower. Members of this genus have long been used in all types of gardens for their hardiness and free flowering. Three species, all easy from seed, were tried:

C. carpatica, or Carpathian Bellflower, with lavender-blue or white flowers, usually stays under 12 inches, forming compact bushy plants. Seedlings started in February bloom sparingly from July till frost.

C. fragilis has no common name and do not be misled by its specific name—this plant is far from being fragile. Certain individuals bloom the first year from seed, starting in July. Clusters of light blue-purple flowers are borne on prostrate stems trailing from the center of the plant which has almost succulent, very dark green, fan-shaped leaves. It grows to 6 inches high when matured and seems to do well in either sun or shade.

C. garganica from Greece and Italy is another 6-inch plant, with light green leaves arranged in cushions studded with star-shaped blue flowers. It does not bloom the first season, and is just a trifle fussy.

Erigeron montanensis — Fleabane. This is another native from the badlands and high plains. It does not flower the first year and is quite slow growing. The largest plant I was able to grow stands about 1-½ inches tall. The mature plant is 5 inches tall, with many small white, daisy-like flowers. It is easy from seed and commendable because of its low, rosette habit.

Gypsophila repens — Baby's Breath. At first glance, the creeping Baby's Breath suggests a *Dianthus* in appearance, but its gray-green leaves are much shorter than the latter. Once started, the young plants grow quickly but not too aggressively, and may produce a few pink blossoms by the end of the first season.

Lychnis alpina — Campion. This plant, although not flowering the first year, is tough, attractive and apparently heat-resistant. It has a wonderful rosette habit with dark green, stiff, strap-shaped leaves forming a bristly cushion. Mature plants are 6 inches high, producing rosy-pink blossoms in April.

Penstemon — Beardstongue. There are many species and varieties belonging to this genus, but the smaller native species are best suited to the sink and rock garden. Seeds of the species below should be sown outside in the coldframe, and the plants require extremely well-drained soil.

P. glabrescens is really a very dwarf shrub with loosely-spaced, light-green, narrow leaves. The mature plant, with spikes of blue flowers, stands only 5 inches high.

P. procumbens is an evergreen, creeping mat-former to 3 inches, bearing bright blue flowers over tiny, shiny leaves. Part shade, as defined earlier, is required for this species.

P. virens, another mat-forming evergreen, is somewhat larger than the preceding. It produces rich blue-purple flowers to a height of 8 to 10 inches. This species actually requires half shade.

Silene — Catchfly. Three species of this were tried, but only one, S. *alpestris,* grew willingly and flowered the first season. The plant itself grew 3 or 4 inches, high, with white flowered panicles rising to about 6 inches. The other two species, S. *acaulis* and S.

Schafta, grew well for awhile, but many of the plants seemed to die back after growing well for 2 or 3 months. I think they would be worth trying again, however, planting them in a soil mixture of 3 parts sand, 1 part gravel, 1 part soil, and 1 part sifted leaf mould or peat.

Townsendia hookeri (sometimes *T. sericea),* a native composite, should prove to be one of the most delightful additions to any sink or rock garden. The mature plant is a gray-green tuft 4 inches wide, topped with white or pink daisy-like flowers, all under 2 inches.

Veronica—Speedwell. Two species, *V. holophylla* and *V. Repens,* were grown satisfactorily, although neither bloomed the first season. The former is a little on the tall side, but produces slender spikes of densely crowded, bright blue flowers, while the latter is a small blue-flowered creeper which stays under 3 inches. It would also be useful between stones in a patio.

Not to be overlooked are the many attractive native plants that can be found growing in open or uninhabited places around the St. Louis area. To mention a few, there is *Talinum teretifolium,* a succulent producing ephemeral magenta flowers on wiry stalks; *Hypericum gentianoides*, a bushy little 8 to 10 inch shrub, the branches of which are covered with diminutive yellow flowers, and appear to be jointed; and *Selaginella rupestris,* a tiny fern relative. This may have to be purchased and would cost up to $2.00 a clump by mail order.

Bulbs would happily find a place in the sink garden. I would suggest some of the smaller, winter-blooming varieties of Crocus, and miniature species of Narcissus and Tulip which are available from quite a number of seed and bulb dealers.

There are hundreds of plants, other than those described above, that would be very suitable in the sink or rock garden. I would suggest again, that if several people became interested in this type of gardening, they each grow a number of different plants with the idea of exchanging them between one another. This can be done among friends or neighbors, as well as among members of garden clubs.

Plants should be planted carefully so that the crown of each sits about one-half inch above the soil level. When the planting of the sink is completed to satisfaction, the half inch left near the top can be filled with a gravel mulch that should be worked in closely around and under the plants. Not only is the gravel attractive, but it allows the crowns of plants to be well aerated, and serves to hold down weeds.

There are some advantages of the sink garden that are not apparent. For one thing, it is a rather delightful way to get rid of an old, unwanted sink. It is a garden that does not require back-breaking spading each spring, nor does it present a weeding problem. Being above the ground, it is easy to reach and is not bothered by dogs, cats, rabbits and other quadrupeds. Perhaps the single most important advantage of the sink garden is that it does not require regular watering. In the spring when rains are quite frequent, there is little or no need to water. Later in the summer and fall, when drouth conditions are apt to prevail, one watering per week should suffice. All of this adds up a minimum of care required to maintain the sink garden. Although setting up the sink requires a deal of labor, it certainly is no more work than building a barbecue pit or flagstone patio.

It is only fair to mention some difficulties, although there is no garden of any kind without these. Occasionally, the plants will have to be sprayed for aphids and possibly white-fly. In mid-summer, caterpillars may cause trouble and must be sought for at the first sign of damage. Even though four-legged creatures are no problem, the two-legged ones are, namely; birds and neighbors' children. Any suggested controls for the latter might bring a reign of terror upon the author, so the solutions to these problems are best left to the reader.

Seed Companies

Claude A. Barr Prairie Gem Ranch Smithwick, South Dakota	For seeds, bulbs and plants native to the midwest.
Geo. W. Park Seed Company Greenwood, South Carolina	Primarily for seeds and blubs.
Pearce Seed Company Moorestown, New Jersey	For seeds, bulbs and plants.

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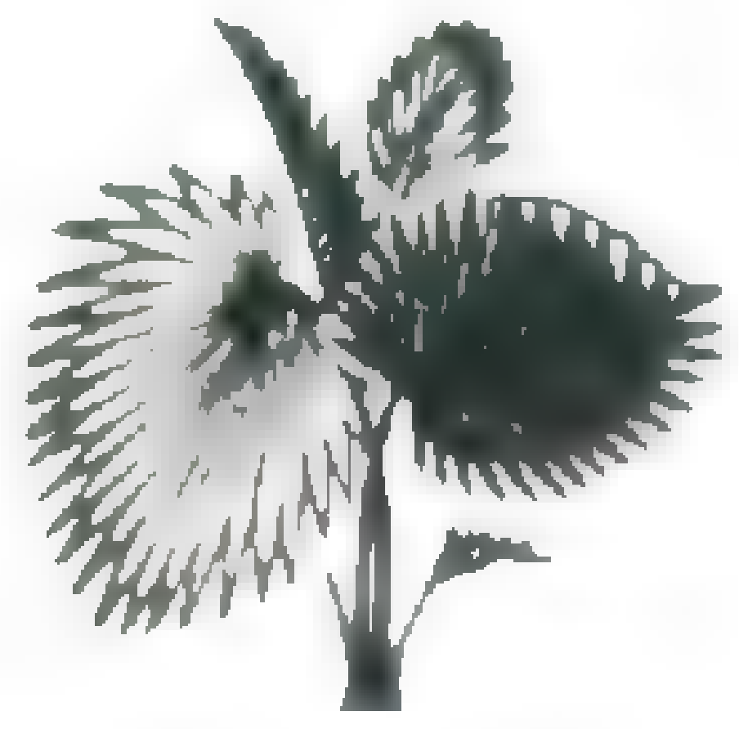

PINK MAIDS

Mrs. Gilbert, a veteran member of the St. Louis Horticultural Society, brought some branched sprays of small pink flowers to Horticultural Society meetings on several occasions. They interested me so much that when she contributed seedlings to the annual plant sale, I bought some and have had them in my garden ever since. I finally identified them as a species of Talinum ordinarily called *Talinum patens*. Flower catalogues however list it as *Talinum paniculatum* which is apparently the accepted name. An old-fashioned and appropriate common name is PINK MAIDS. They seed themselves here and there in my garden and begin to flower in early summer when they are only a few inches high. If given plenty of room and sunlight, they thrive in the St. Louis heat and make graceful bushes almost waist high before the first frost.

At the base they are a typical succulent with thickish green leaves set opposite each other on brittle bright stems. On small plants the leaves are no larger than your thumb nail but on well grown specimens they may be nearly the size of your hand. Young and old, the flowers are borne high above the plant on gracefully branching wand-like inflorescences on which the buds and seed pods shine like tiny bright colored beads. The day before they open, the buds are a bright mulberry pink. After flowering the young seed pod (about the size of a pin head) is a dull mulberry purple, which becomes brighter as the seed ripens until it is almost a bright light red. Then the color fades to straw and the seed pod shatters. These mingled colors in a single inflorescence—mulberry, purple, bright red, and straw, produce an oddly unreal effect, as of multicolored glass beads.

It is these beaded wands of bloom rising high above the clean fresh leaves, that are the plant's chief charm during most of the day. The flowers do not open until late in the afternoon and close in the early dusk of the same day. The open flowers are about half the size of your fingernail and a soft bright pink, which contrasts oddly with the dull purple and bright red seed pods.

The tiny seeds apparently spread all through the garden but the plants have the useful quality of coming up only in empty spaces between other plants and staying quite small unless there is a big gap, as for instance at a place where there have been clumps of daffodils in the early spring, producing a summer bare spot when the leaves died down quickly in late May and early June. For several years I had only a few large plants each year and these were mostly just inside my thick and sturdy evergreen barberry hedge. This last spring I had the hedge cut back severely to keep it within bounds, thus creating a wide open space between the barberry plants and the macadam walkway at the side of my garden. After the early crocuses had died down, this was a bare stretch of chopped wood mulch until the Pink Maids began to come up here and there along the whole stretch of it, rejoicing in having found at last a sunny spot very much to their liking. During the summer, delivery trucks have backed into them or autos have run over them creating great havoc among the brittle succulent stems and leaves but when cut back cleanly they recover in just a few days and branch out more vigorously than before they were injured.

I became so interested in my bright little PINK MAIDS, that I looked them up in the library and the herbarium to learn that they are native to rocky and sandy places from Mexico to Chile. In the tropics and subtropics they develop into succulent shrubs which are actually woody at the base. In Europe they have been quite commonly grown as potted plants for their foliage and flowers. They are apparently easily grown except that, as in my garden, they demand plenty of light. There is even a variegated form with a white-edged leaf which is grown just as a succulent for the beauty of its foliage. In Belem, on the coast of Brazil, the succulent leaves are gathered in the wild and are sold in the market to be used as a green vegetable. I do not know of any other plant which appears in such an odd variety of habitats (1) as a succulent sub-shrub very widely distributed in the tropics and sub-tropics of the New World, where it is sometimes used as a green vegetable (2) as an ornamental potted plant in European greenhouses (3) as a self-sown annual in an occasional American garden.

—E.A.

GROUNDSEL TREE - SALT BUSH

The Garden has an excellent selection of the Groundsel Tree or Salt Bush as it is known along the seashore, *Baccharis halimifolia,* L. It has been propagated and widely planted in the border plantations near the lily pools. The plant is chiefly of interest for the plumes of snowy white pappus of the fruits in late September and October. The white plumose branches are also attractive when used as fillers and background in flower arrangements.

Baccharis halimifolia, L. and the closely related western species *B. salicina,* Torr. and Gray are hardy in our area. They grow in almost any well drained soil in a sunny position and are well adapted to dry rocky slopes. They will also tolerate brackish soils thus making them valuable for seashore plantings. —E.L.E.

SUMMER NATURE PROGRAM AT THE GARDEN

This summer 472 children registered for the Pitzman Nature Program, which was held for two 5-week sessions, under the trees near the Main Gate. Not all of this large number received their final certificates, as vacations and camps sometimes prevented the children from attending the required number of periods.

This year the classes were held on four mornings of the week, instead of two days a week, with both morning and afternoon classes as in previous years, thus using the cooler hours of the day, which greatly increased the powers of application and interest of the students.

The program followed the same pattern as the two previous years, the members of the St. Louis Audubon Society generously giving of their time to take the classes in Birds, while Mr. Peck and Miss Davies led the classes in Plants and Man, Man's Enemies and Trailfinders. This year we were very ably assisted by five students from local schools, who have been coming to all our classes during the last two years. They have shown such interest and aptitude, we have formed them into a group named "The Assistants' Council". In addition to helping in the classes, they have spent the summer working on a display of fossils which has been set up in the Museum; they hope, during the year to fill the remaining cabinets with similar displays.

In the afternoons, members of the Junior Research Teams, selected from interested students in the morning classes, worked on a number of projects. In the first session, six students studied the structure of different flowers growing 'round the Garden, and then spent several afternoons watching and collecting the insects that visited these flowers, relating them to the fertilization of the flowers. Five very intrigued children fished for, studied under the microscope, sketched and named many of the algae they found in the pond; this was so successful that we repeated it the second session. The third project was a repeat of last year's count and collection of lawn weeds, the account of which was written up in the September '59 BULLETIN.

In the second session, two girls made a good report of the life of the Elm Leaf Beetle and the damage it is doing to our trees. The final project was an anatomical and morphological study of the plants growing around and in our pond; we are pleased to report this was accomplished with only two accidental slips into the marshy pond edge.

We find the interest shown by the children in the Garden's nature classes very gratifying, and are pleased to see many of the same children coming back for the second and third summers. They perhaps will be the botanists of the future—although one seven-year-old has his life very definitely planned for a career in Entomology.

—J.L.D.

FLOWER SHOWS

Annually, beginning with the Fall Season, the Garden presents four major flower shows in the Floral Display House for the benefit of the Friends of the Garden and the general public. These contribute color and interest when the outdoor garden is more or less dormant and less colorful. The first of the displays is the Chrysanthemum Show in November (this year November 6th through December 4th). The Christmas Season is celebrated with a display of Poinsettias and other Christmas-time plants. The Orchid Show in mid-winter will be held this year in cooperation with the first annual Orchid Show of the Orchid Society of Greater St. Louis. It will include many out of town exhibits and have Orchid Society judging. This is one of the more spectacular shows and is eagerly awaited each year by Orchid fans as well as all other flower lovers. The final big show is the Spring Flower Show about Easter time. This show features mainly tulips, narcissi, lilies, other bulbous plants and azaleas. Pictured are views of the Centennial year Chrysanthemum Show last November and the Spring Flower Show of the past season.

During the year are other shows, competitions and festivals sponsored by the various garden clubs and flower societies. Beginning in the Fall these include the Henry Shaw Cactus Society Show, the Dahlia Society Show, the Men's Garden Club Fall Festival; in the Spring the African Violet Show, the Narcissus Society Show and the Rose Society Show; in the Summer the Gladiolus Society Show.

Chrysanthemum Show for the Centennial year 1959

Spring Flower Show April 1960

MISSOURI BOTANICAL GARDEN PROGRAMS

Special Shows and Displays:

Chrysanthemum Show November 6 through December 4.

Poinsettia Display December 11 through January 8.

Free Nature Programs for Children, age seven and over, are held every Saturday morning from 10:00–11:30 A.M. in the Museum Building.

Program for November and December:

Color Sound Movies	November	5
The Rise of the Forests		12
Woodlands of America I		19
Woodlands of America II		26
Insectiverous Plants	December	3
Make Your Own Christmas Decorations		10
Make Your Own Christmas Decorations		17
Color Sound Movies		31

COURSES

The following courses are open to any interested person. Certificates are awarded upon the successful completion of any course.

Information on registration may be obtained by calling

PRospect 6-5567

Please send all registration fees to

Missouri Botanical Gardens
2315 Tower Grove Avenue
St. Louis 10, Missouri

Registration fees cannot be refunded after the last day of registration for any particular course.

COURSE 107

Botany for Home Gardeners

Place: Museum Bldg.

Time: Five Monday nights, 7:30 to 9:30 P.M.

Starting November 14.

Fee: $15 for the five sessions.

The course emphasizes basic structure of both herbaceous and woody plants, the nature of changes which adapt plant parts to particular situations, seed structure and germination of both monocotyledonous and dicotyledonous plants, and familiarization with chromosomes, cell division and sex cell formation. The course will be taught as a laboratory-discussion, and will be built around fundamental observations essential to intelligent understanding and growing of plants. No previous knowledge of plants is required.

Open to all persons of any age seriously interested in plants.

Instructor: Dr. Norton H. Nickerson

COURSE 128

Modern Horticulture for Home Gardeners II

Place: Museum Bldg.

Time: Five Tuesday nights, 7:30 to 9:30 P.M. Starting November 1.

Fee: $15 for the five meetings.

Complements Course 123 but may be taken independently. Subject matter includes background knowledge essential to really successful growing of many types of plants. An orderly survey of environmental factors which affect plant growth and how the home gardener can manipulate these factors to achieve good growing results. Soil testing and what to do to improve soil conditions found on your property, plant propagation and plant diseases will be included. Each evening will feature both practical and classroom work. Students may take home plant material at end of each meeting.

Instructor: Mr. Robert J. Gillespie

COURSE 146

Advanced Orchid Growing—How to Make Orchids Flower

Place: Museum Bldg.

Time: November 16, 7:00 to 10:00 P. M.

Fee: $5 for one meeting.

A course for the advanced orchid grower, stressing how environment influences growth and flowering in the major cultivated genera of the Orchidaceae. Lights and other devices for controlling flowering will be explained. There will be a laboratory session followed by a question and answer period.

Instructor: Mr. Robert J. Gillespie.

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AN IMPORTANT MESSAGE TO

Friends of the Garden

Major financial support for the Garden's Second Century Redevelopment Program depends in part upon tripling membership in the Friends, as evidence of community interest. If this is accomplished, the Redevelopment Program can move ahead without delay. Thus each new member has greatly added importance at this time and the Friends have a unique opportunity to provide the most significant help to the Garden in its long history.

If every Friend of the Garden would find one additional member, the 1960-61 membership goal of 7,500 Friends could be more than three fourths met and very substantial funds gained for Shaw's Garden.

BE A FRIEND AND BRING A FRIEND

Membership is $10 and up.

For information and membership blanks call or write

Friends of the Garden
PRospect 6-5567
2315 Tower Grove Avenue
St. Louis 10, Missouri

MISSOURI BOTANICAL GARDEN

Bulletin

December 1960
Volume XLVIII
Number 10

COVER: COLORADO SPRUCE *(Picea pungens)* growing in the Aboretum. Photo September 1960.

CONTENTS

Flower Sunday at Christ Church Cathedral
Initiated by the Legacy of Mr. Shaw
"God in Nature and in Christ"
Significance of the Privately-Operated Botanical Garden
Garden Gate Festival
Missouri Botanical Garden Programs
General Index

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Missouri Botanical Garden Bulletin

Vol. XLVIII No. 10 December 1960

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join me in

extending the

Season's

Greeting

and our sincere

thanks to the

many friends

of the Garden

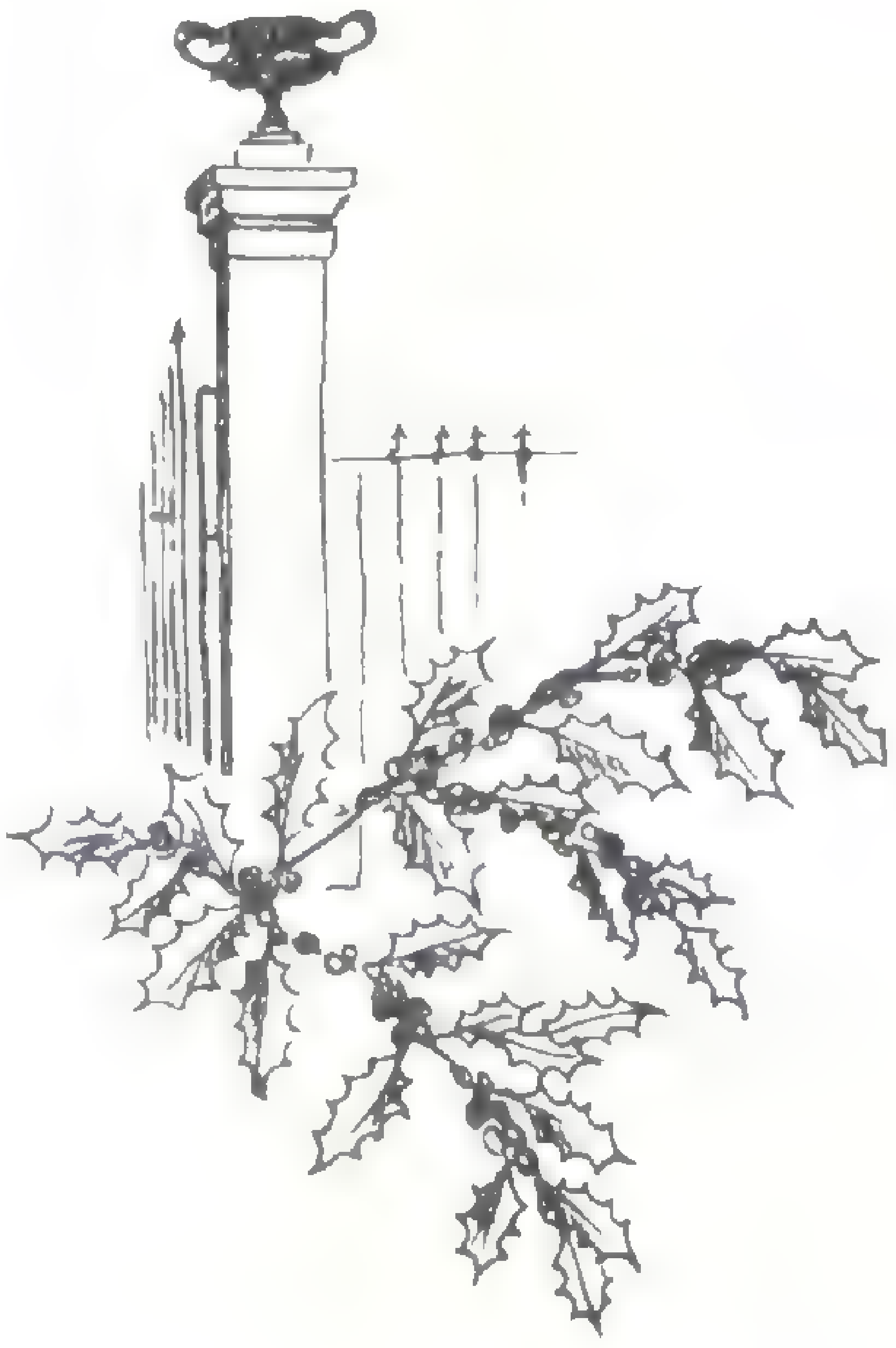
for their loyal

support during the

first year of our

Second Century

Frits Went



FLOWER SUNDAY AT CHRIST CHURCH CATHEDRAL INITIATED BY THE LEGACY OF MR. SHAW

"I hereby devise and bequeath two hundred dollars annually to the Bishop of the Episcopal Church of this diocese, in consideration (if he approve of the same) that an annual sermon be preached in such church, and by such minister as he may select; on the wisdom and goodness of God as shown in the growth of flowers, fruits and other products of the vegetable Kingdom; to be paid annually out of the funds of the said Botanical Garden". So reads the will of Mr. Shaw (Fourth Clause, paragraph 26). The first Sunday following Easter has been set aside annually and designated "Flower Sunday at Christ Church Cathedral" St. Louis. Each year since Mr. Shaw's time the speakers have used this flower theme. The church is also elaborately decorated with flowers from the Missouri Botanical (Shaw's) Garden.

This past year (April 24, 1960) the sermon "God in Nature and in Christ" was delivered by the Very Reverend Dr. John B. Coburn, Dean of the Episcopal Theological School at Cambridge, Massachusetts. Dr. Coburn's message, like that of so many of his predecessors, has so admirably carried out the intent of Mr. Shaw that we are reprinting this latest one for the pleasure of the Friends of the Garden. Although the sermon was delivered originally at the Easter Season, it is of a timeless character and is, we think, quite as appropriate at this Christmas Season.

GOD IN NATURE AND IN CHRIST

John B. Coburn

May I say, first of all, what a privilege it is for me to share in the traditional Flower Sunday service in this Cathedral. Perhaps you will permit, by way of introduction, three personal words of appreciation.

First, for generations the ministry of this Cathedral Church to this city and state and its witness to the essential unity of Christ's Church through its relationship with other Christian communions have made it one of the great churches in our land. I am privileged at last to see that Cathedral of which I have heard so much.

Secondly, either through personal friendship or as a member of the family of the Episcopal Theological School I am honoured to stand in a pulpit occupied by such friends and alumni as Bishop Scarlett, Bishop Lichtenberger, Bishop Cadigan, Dean Sweet and Dean Cole. The School is happy to be known and judged by such graduates as these.

Finally, I am pleased to speak upon such an occasion as this when a conscious relationship between God and nature is recognized. This is a theme which currently is in disfavor theologically; it is one in which I believe heartily; and I am grateful for this opportunity to affirm it as part of the Gospel of Christ.

. . . .

Have you ever had the experience

out in the country during the summer of sitting down alone under a tree when all is quiet? Then the stillness is broken by the sound of fluttering. You look up and watch the leaves brushing against each other and the branches swaying. You wonder where the breeze has come from. Then the sound stops, and you wonder where it has gone.

Or have you ever had the experience, when you were under that tree, of sitting down and leaning against its trunk? Have you ever closed your eyes and shut out the external world so that you might press back against the trunk and imagine yourself merging into it, and you say to yourself: "I wonder what it's like to be a tree—rooted . . . grounded . . . sturdy . . . stretching?"

Have you ever been out in a field on the side of a hill at dusk? Did you ever stretch out on the ground and bury your face in the grass and smell the earth; then when you raised your head you felt the warm breeze come down off the hillside, and you put a blade of brass in your mouth and chewed on it; and as you looked out over the valley and twilight fell, there seemed to be a sudden hush in the world, almost as though the earth stood still for a moment? You were caught up in the world of nature that in turn seemed to be caught up in something beyond itself; almost as though in its recognition of that something more it seemed to bow down before it? And when later you walked down the hill spitting out the chewed-up bits of grass you were thoughtful, reflective, a little bit different, as though you had been invited into another world and brushed against another spirit?

Most of us sometime in our lives—and some people many times— have experiences such as these. Young people in particular have them with intensity. They are part of the common human heritage where, usually through the world of nature, we are put in touch with mystery. We suddenly become aware of, or at least suspect, a world beyond our physical world, a spirit that impinges upon our existence, a mysterious realm around us that compels our attention.

You may remember that scene in *The Wind in the Willows* where something like this happened to those good animal friends, Rat and Mole. Let me remind you for a moment of their adventure.

At one point in the book the baby otter is lost. Mole and Rat set out in their boat into the river to try to find him. They go upstream, searching the river bank. Darkness falls. The moon comes out and lends her light. They patiently continue their search, going steadily further upstream; the moon sinks finally into the earth; darkness and mystery descend. Then in the pre-dawn hush a change begins to take place.

> The horizon became clearer, field and tree came more into sight, and somehow with a different look; the mystery began to drop away from them. A bird piped suddenly, and was still; and a light breeze sprang up and set the reeds and bulrushes rustling. Rat, who was in the stern of the boat, while Mole sculled, sat up suddenly and listened with a passionate intentness. Mole, who with gentle strokes was just keeping the boat moving while he scanned the banks with care, looked at him with curiosity.

He hears something. Then he loses it. Then it comes again.

> "O, Mole!" he says, "the beauty of it! The merry bubble and joy, the thin, clear happy call of the distant piping! Such music I never dreamed of, and the call in it is stronger even than the music is sweet! Row on, Mole, row! For the music and the call must be for us."

So in silence Mole rows steadily on. Then he too hears the distant piping; it breaks upon him, catches him up and possesses him utterly. It brings both pain and joy. The sound draws nearer. The boat comes to rest on the shore of an island.

> "This is the place of my song — dream, the place the music played to me," whispered the Rat, as if in a trance. "Here, in this holy place, here if anywhere, surely we shall find Him!"
>
> Then suddenly the Mole felt a great Awe fall upon him, an awe that turned his muscles to water, bowed his head, and rooted his feet to the ground. It was no panic terror — indeed he felt wonderfully at peace and happy — but it was an awe that smote and held him and without seeing, he knew it could only mean that some august Presence was very, very near. With difficulty he turned to look for his friend, and saw him at his side cowed, stricken, and trembling violently. And still there was utter silence in the populous bird-haunted branches around them; and still the light grew and grew.
>
> Perhaps he would never have dared to raise his eyes, but that, though the piping was now hushed, the call and the summons seemed still dominant and imperious. He might not refuse, were Death himself waiting to strike him instantly, once he had looked with mortal eye on things rightly kept hidden. Trembling he obeyed, and raised his humble head; and then, in that utter clearness of the imminent dawn, while Nature, flushed with fullness of incredible colours, seemed to hold her breath for the event, he looked in the very eyes of the Friend and Helper; saw the backward sweep of the curved horns, gleaming in the growing daylight; saw the the stern, hooked nose between the kindly eyes that were looking down on them humorously, while the bearded mouth broke into a half-smile at the corners; saw the rippling muscles on the arm that lay across the broad chest, the long supple hand still holding the pan-pipes only just fallen away from the parted lips; saw the splendid curves of the shaggy limbs disposed in majestic ease on the sward; saw, last of all, nestling between his very hooves, sleeping soundly in entire peace and contentment, the little, round, podgy, childish form of the baby otter. All this he saw, for one moment breathless and intense, vivid on the morning sky; and still, as he looked, he lived; and still, and he lived, he wondered.
>
> "Rat!" he found breath to whisper, shaking. "Are you afraid?"
>
> "Afraid?" murmured the Rat, his eyes shining with unutterable love. "Afraid of Him! O, never, never! And yet — and and yet — O, Mole, I am afraid!"
>
> Then the two animals, crouching to the earth, bowed their heads and did worship. Sudden and magnificent, the sun's broad golden disc showed itself over the horizon facing them; and the first rays, shooting across the level water-meadows, took the animals full in the eyes and dazzled them. When they were able to look once more, the Vision had vanished, and the air was full of the carol of birds that hailed the dawn.

You see and hear the fluttering leaves; you press back in the trunk of a tree; you watch twilight fall in the valley. And should you be asked, "Friend, are you afraid?", you might answer with Rat, "Afraid, afraid of *Him!* O, never, never! And yet — and yet—O, Mole, I *am* afraid." And then you might with them both bow your head and worship.

These experiences, these little "breakings in" as from another world are what Elizabeth Vining (in her book, *The World in Tune)* calls "minor ecstacies." They are part of the common currency of human experience. Indeed at certain stages of our lives they may provide the most real world where we live on the deepest level of our existence. They may provide on the one hand nothing more than a momentary lift of the spirit as a shaft of light from the sun filters into the shade of a wooded grove or as a wave crashes and thunders on a sandy beach. Or, at the other extreme they may provide the entrance into another world of beauty and mystery whose spirit gradually possesses one's own spirit and transforms it. This is the world where the artist and the poet dwell whose eyes see, and tongues tell and hands reveal a world no less real because most mortals do not dwell there.

For our purposes, however, these experiences take on special significance because they may mark the religious awakening of the human spirit. Indeed they may be — alas! — the sum total of the religious experience of many. But that danger should not deter us from seizing boldly the opportunities offered by them to be led into the presence of God.

The theme of this sermon then is just this: The response of the human spirit in such experiences as these is the response of man to God. God may act openly or hiddenly in and through these experiences in nature. It is a theme which I trust is not contrary to the spirit of those who founded "Flower Sunday" in this Cathedral Church.

This theme can be presented poetically. Indeed William Blake has done so in this verse:

I give you the end of a golden string
 Only wind it into a ball,
It will lead you in at heaven's gate,
 Built in Jerusalem's wall.

The "golden string" is let down by God — the first religious awareness in the world of nature. Take it as such — as coming from God — respond to it, wind it; it will lead you in at heaven's gate, built in Jerusalem's wall.

The world of innocent nature, then — let that word "innocent" be stressed, for fallen nature wrecks havoc and destruction and bears the power of evil — provides "signs of this presence" of God himself extending golden strings into the lives of men and women and children, that they may wind them into a ball to lead them into Jerusalem's wall. This world where God breaks through is a place, says Lord Tweedsmuir in *Pilgrim's Way* of inexhaustible beauty but still more it is "the husk of something infinite, ineffable and immortal, in very truth the garment of God."

Let us take one further step in our thinking. If this world then is "in very truth the garment of God" it must be of the God who was in Christ reconciling the world unto Himself. Nature cannot reflect some other God — a pantheistic God unconcerned about distinctions between right and wrong, a God of nature who absorbs his creatures in a nature-mysticism, a God less than the one who died for us on the Cross — for the God of nature is the Father of our Lord Jesus Christ, one God. So let me in these final words simply point in one direction where you may be helped to see—no, experience—golden strings as sacramental experiences of the presence of Christ who took upon himself our flesh and lived in our world. Let me point briefly to three guideposts that mark the direction.

Before Christ died on a Cross, he was born in a stable; before his death expressed God's mind, his birth showed God's love. "God so loved the world that he gave his only begotten Son . ." The Incarnation is given.

So all golden strings are given. We cannot call them forth; we do not deserve them. All we can do is receive them. They are "incarnational" in character — the "givenness" of the wind, leaves fluttering, the earth standing still, the song of a lark. This is the first guide-post: the "givenness" of the Incarnation.

And the second is: mystery, awe, transcendence, holiness. On that first silent night the angels appear out of nowhere before the shepherds watching their flock and sing "Glory to God in the highest." And the shepherds were frightened with a holy awe. And the other Nativity story is, of course, the wise men from the East bringing gifts — gold, and frankincense and myrrh — and bowing down before Him offering Him homage.

So every golden string bears mystery. Each one comes out of a mysterious "other" world—nobody knows how it comes or why or where it goes. It comes as a flash of lightening in the dark, or a cry in the stillness, or a whisper as a falling leaf — touched with mystery, transcendent, awesome.

And the third guide post is this: Christ was born that we might be born anew. He came to change us: to adopt us as sons. Augustine put it this way: the Son of God became the son of man in order that the sons of men might become the sons of God. What a difference the Incarnation makes!

And so in some small measure, on an infinitely less scale in our little personal lives the golden strings make us different. They inspire us, frighten us, make us more solemn or less solemn perhaps, give us a touch of happiness, put us in touch with the scource of happiness, give us something of that inner joy which "the world can neither give nor take away." They may even at their best — and our best — make us more holy.

Whatever our own golden strings may be — the wind blowing, leaves fluttering, a lark singing, the sun rising, the waves pounding — they are of nature and of more than nature. They are "the husk of something infinite, ineffable, and immortal, in very truth the garment of God."

And if we wind the end of our golden strings they will lead us in at heaven's gate, built in Jerusalem's wall — the dwelling place of the most high God, even our Lord Jesus Christ to whom be glory for ever and ever. Amen.

SIGNIFICANCE OF THE PRIVATELY-OPERATED BOTANICAL GARDEN

R. J. Seibert

A botanical garden should first of all be attractive, interesting and beneficial to those who support it. It must be operated from private endowments and subscriptions, or from public funds which are either directly appropriated or are grants for support of research and educational institutions. "A garden operated entirely from public funds is frequently subject to the whims of those not necessarily concerned with its over-all operation or the philosophy and purpose for which the garden was estabilshed. Its operation is further frustrated by the ups and downs of fiscal fluctuations resulting in feast or famine budgets which often cause corresponding spurts of over-enthusiastic pursuits of new features, followed by periods of doldrums. The financing, whether public or private, needs responsible leadership with control measures to provide a realistic and continuous smooth-flowing operation which does not become static on the one hand, or over-ambitious on the other."

A number of botanic gardens in this country have, to a great extent, gained financial stabilization by joining forces with their city, county or other governmental agency in arranging for:—1, public funds to support and maintain those portions of the over-all program which are seen by and concerned directly with the public; 2, utilization of their private sources of funds and endowment income for scientific research. This method is used by such well-known gardens as the New York Botanical Garden, the Brooklyn Botanical Garden, the Los Angeles State and County Arboretum, and the Fairchild Tropical Garden near Miami, to name a few.

The privately-operated botanical garden, it is realized, must be basically financed — someone must give it funds — someone must assure that these funds are ever-present, and someone must be sure the garden operates within the available amount. The government encourages you to support this type of non-profit research and educational work by allowing contributions to be deductible from your income tax. It is through this method that significant advances in human welfare can and will continue to make their mark free from governmental interference.

The Missouri Botanical Garden established by Mr. Shaw, and since its inception through Mr. Shaw's foresight, has gained and maintained world-wide prominence in the field of botany. It is privately operated with the income from Mr. Shaw's endowment, public contributions and from research grants by governmental agencies. The garden has never been static. It has made every effort within its means to keep within the demands of the times. One need only to remind you of its prominent place as a leader in the fields of Physiology, Mycology. Taxonomy, Genetics, Floristics—all fields of fundamental research. Its library and herbarium are research tools comparable to the best in the country. Its Garden and Arboretum have been the envy of other institutions and the pride of St. Louis. Its improvements in such important plant families as orchids and water lilies have made this garden famous all over the world.

This first week in October you have seen the dedication of a modern climate-controlled greenhouse, one means of advancing with the times in plant science. If man is to exist on earth or in space anywhere under a continuously-exploding population, he must devote a full measure of manpower, time, money and modern facilities on imaginative research, using plants available at present here on this earth. You already know this costs money. You also know the Missouri Botanical Garden has contributed magnificently to these researches. It is now embarking on a new and far greater contribution to mankind—of course with your support.

There are a number of these interesting and privately-operated botanical gardens in this country. Prominent among them are the Longwood Gardens established by a farsighted industrialist, Mr. Pierre S. Dupont, in Chester County, Pennsylvania. The prime purpose of this Garden is to

Entrance to Longwood Gardens
Formal Planting of Annuals in the Foreground

Flower Garden and Fountain in Longwood Gardens

provide a Horticultural Display for the enjoyment of the public, but behind the scenes much work and research goes on to make the exhibits beneficial and educational. This Garden, like Shaw's Garden, cooperates with other agencies such as the U.S. Plant Introduction Service, the U.S. Forest Service, Bailey Hortorium, Morris Arboretum, Pennsylvania State University, and the University of Delaware, in promoting plant research in its many phases.

The talk was beautifully illustrated with numerous color slides of flowers and scenes in the Longwood Gardens, two of which are reproduced here.

Summarized from address of Dr. R. J. Seibert, Director of Longwood Gardens, for the Climatron Opening, October 3, 1960.

GARDEN GATE FESTIVAL

The Women's Association of the Garden is making plans for the second Garden Gate Festival to be held next May (date to be announced later) on the parking lot of the Famous-Barr Company in Clayton, Missouri. The proceeds will benefit the the Missouri Botanical (Shaw's) Garden. Cuttings and other starts of many kinds of plants are being made and readied for the Spring event.

Due to the unusual interest in the Herb Society booth at last year's Festival an early start in this line is being made to assure adequate supplies of fresh and dried herbs, herb mixtures and other items for the herb fancier.

MISSOURI BOTANICAL GARDEN PROGRAMS

Poinsettia display December 11 through January 8.

Orchid Show January 29 through February.

Free Nature Programs for children, age seven and over, are held every Saturday morning from 10:00–11:30 A.M. in the Museum Building.

Program for December and January:
Insectiverous Plants ... December 3
Make Your Own Christmas Decorations ... 10
Make Your Own Christmas Decorations ... 17
Color Sound Movies ... 31
Dead or Alive ... January 7
Winter Puzzles ... 14
Do You Have a Green Thumb? ... 21
Jungle Plants ... 28

COURSES

The January issue of the BULLETIN will list all courses for the year 1961.

GENERAL INDEX

Achillea, 151, 153 A. millefolium, 118
Agropyren repens, 126
Agrosta alba, 114 A. canina, 114, A. palustris,114
Allamanda cathartica, 70
Allium sp., 126
Alyssum, 151
An Executive's Garden, 150-156
Anderson, Dr. Edgar, 11, Report for 1959, 40, 108, "The Pellitory Problem", 139, "Trumpet Creeper", 141, "Pink Maids", 157-158
Andrews, Dean Henry N., 37, "Peat for your Garden", 57-61, 108
Androsace, 151
Antigonon leptopus, 69
Apodanthera sp., 14
Aristolochia elegans, 70
Armeria sp., 151
Asplenium nidus, 79
Aster kumleini, 153, A. oblongifolius, 153
Averill, John R., Cover No. 4, 143
Azaleas, 9

Baccharis halimifolia, 158, B. salicina, 158
Baer, Howard F., 71
Barbre, Clarence, 43
Bascom, Mrs. William R., Cover No. 4, 143
Berberis thunbergia, 56
Brenner, L. G., "Fundamentals of Pruning" 20-31, Report for 1959, 51-56
Britt, Mrs. Paul, 44

Bromeliad, 79
Bryan, John Albury, 12, 37
Buersmeyer, Mrs. Irene, 41
Bunting, Dr. Geo. S., 41, "Summer Flowers for Winter Bouquets", 86-90
Burger, William C., 42

Caccia, Sir Harold, 144
Calandrina, 151
Campanula carpatica, 154, C. fragilis, 154, C. garganica, 154, C. sp., 151, 153
Carlina, 151
Cattleya elongata, 139, C. Mrs. John S. Lehmann, 139
Celastrus scandens, 86
Celosia argentea v. cristata, 88
Cerastium vulgatum, 126
Climatron, Cover No. 3, 11, 33, 131
Cobaea scandens, 68
Coburn, Rev. Dr. John B., "God in Nature and in Christ", 164-168
Compte, Dr. and Mrs. Frederick, 41
Cotyledon sp., 151
Cucurbits, Archeological, Dr. T. W. Whitaker, 13-14
Cucurbita, foetidissima, 14, C. molina, 14, C. moschata, 14, C. nixta v. Taos, 14, C. pipo, 13, 14
Culver, Mrs. E. R. Jr., 12, 37, 144
Cutak, Ladislaus, Report for 1959, 47, Book Review "Grow Cacti", 73
Cutler, Dr. Hugh, 11, 13, Report for 1959, 33-40, "Try Gourds in Your Garden" 91-92
Cyclamen, 8
Cynodon dactylon, 115, C. magenesii, 116

Darlingtonia, 1
Darwin, Charles, 6, 7
Davies, Miss Josephine, Report for 1959, 43, "Lianas for House Plants", 67-71, Nature Programs, 159
Davis, Dr. G. N., 13
Davis, Mr. Sam'l. C., 71
Dawn Redwood, 134-136
De Leuw, Emil, 35
Dianthus, 151
Digitaria ischaemum, 116, D. sanguinalis, 116
Dionea mucipula, 3
Dischidia raffesiana, 81
Draba, 151
Dressler, Dr. Robert L., Report for 1959, 54, Book Review "Venezuelan Orchids", 73, 145
Drosera brivifolia, 2, D. sp., 1, 3
Dwyer, Dr. John D., "The Magic of Herbs", 62-67
Duke, Dr. James A., 41, "The First Flower of Our Dawn Redwood", 134-136
Dupont, Pierre S., 170

Eleusine indica, 117
Epiphytes, Dr. F. W. Went, 77-83
Erigeron montanensis, 154, E. sp., 151
Euphorbia maculata, 118
Evinger, E. L., "Ivy Vine or Bush", 10, Report for 1959 47, 54, "Our Good Neighbor", 84-85, "Groundsel Tree-Salt Bush" 158, Flower Shows, 160

Fairburn, David, 136
Faust, Leicester B., 71, 144
Festuca rubra, 114
Flower shows, 160
Flower Sunday, 164
Friends of the Garden, 143
Fuller, Buckminster, 11

Garden Gate Festival, 172
Gentiana, 151
Geum, 151
Gillespie, Robert J., Report for 1959, 45, "Orchid Potting Media", 136-139
Ginkgo biloba, 135
Glechoma hederacea, 125
Globularia, 151
Gloriosa rothchildiana, 69, G. superba, 69, G. virens v. plantii, 69
Gloxinia, 9
God in Nature and in Christ, Dr. John B. Coburn, 164-168
Gomphrina globosa, 87
Grammatophyllum speciosum, 80
Grasses, Dr. Geo. B. Van Schaack, 104-107
Graves, Mrs. Fothergill, 12, 37
Gray, Asa, 1
Gypsophyla paniculata, 88, G. repens, 152, 154, G. sp., 151

Hall, Dr. E. Raymond, 145
Hatt, Dr. Robert T., 145
Hedera helix, 10
Helichrysum bracteatum, 87
Helipterum roseum, 87
Hess, Arthur, 34
Hitchcock, Henry, 37
Horich, C. H., 46
How Nature Prepares for Winter, Dr. F. W. Went, 147-149
Hoya carnosa, 69
Hydnophytum, 82
Hypericum gentianoides, 155

Insectivorous plants, 1
Ipomea, 68

Kalenchloe, 8
Kalytenthaler, Henry J., 42
Kirkbride, Mrs. Warren W., 35, 142
Kohl, Paul A., "Caring for Christmas Plants", 8-9, Report for 1959, 49
Krueger, Mrs. Arthur J., 12

Lagenaria siceraria, 14, 91, L. sp., 13
Lagurus ovatus, 89
Lambert, Sam, "The Darwin Controversy", 7
Lamium amplexicaule, 118
Lawn Establishment and Care, Dr. Robert W. Schery, 109-129

Lehmann, John H., 12, 37
Lewisia, 151
Li, Dr. H. L., Book Review, "The Garden Flowers of China", 15
Lianas for House Plants, Josephine L. Davies, 67-71
Limonium bonduelii, 87, L. sinuata, 88, L. suworowi, 88, L. sp., 87
Lolium multiflorum, 115, L. perene, 115
Londe, Paul, 34
Longwood Gardens, 170, 171
Lunaria annua, 89
Lychnis alpina, 154, L. sp., 151

Mackey, Eugene, 33, 35
Magic of Herbs, Dr. John D. Dwyer, 62-67
Maurandia barclaiana, 69
Medicago lupulina, 118, 119
Metasequoia glyptostroboides, 134-136
Milan, Mrs. Walter H., 12
Miscanthus floridula, 89
Mollugo verticillata, 118, 119
Muhlenbergia schreberi, 116
Myrica, 86
Myrmecodia, 82

National Council of State Garden Clubs, 84, 85
Nepenthes dominii, 5, N. sp., 3
Nickerson, Dr. N. H., "A Garden Contribution to Secondary Education", 107-108
Nixon, Mrs. Richard M., 144
Nemastylus, 151
Nymphaea Burtii, 95-97, N. capensis v. zanzibariensis, 97, N. castaliiflora, 95, 97, N. ovalifolia, 95, 97, N. sulfurea, 97, N. sp., 93, 98

Orchid Potting Media, R. J. Gillespie, 136-139

Paritaria pensylvanica, 140-141
Paspalum dilatum, 126
Passiflora caerulea, 68, 69, P. incarnata, 68, 69, P. mollissima, 68, 69
Patterson, Prof. Bryan, 37
Peat Bogs, Dr. Henry N. Andrews, 57-61
Peck, Kenneth O., Report for 1959, 43, "An Executive's Garden", 150-156, Nature Programs, 159
Pennisetum alopecuroides, 89
Pentstemon glabrescens, 154, P. procumbens, 154, P. virens, 154, P. sp., 151, 154
Pfeifer, Howard, 42
Pflager, Henry, 71
Physalis alkekengi, 89
Pink Maids, Dr. Edgar Anderson, 157-158
Plantago lanceolata, 118, P. major, 118
Plants of Prey, Dr. F. W. Went, 1-5
Platycerium bifercatum, 80
Platycodon, 151
Plumbago capensis, 70, P. indica, 70, P. sp., 70
Poa annua, 112, P. Compressa, 112, P. pratensis, 112, P. trivalis, 112
Poinsettia, 8
Polygonum aviculare, 118
Primula, 151
Pring, George H., Report for 1959, 54
Pring, Mrs. George H., 12
Pring, George Wm. "Tropical Water Lilies", 93-98

Safwat, Fuad, 42
Sarracenia, 1
Saxifraga, 151
Schacht, Buelah, 36
Schery, Dr. Robert W. "Lawn Establishment and Care", 109-129
Sedum, 152
Seibert, Dr. R. J., "Significance of the Privately Operated Botanical Garden", 169-171
Selaginella ruprestris, 155
Seteria viridis, 117, S. sp., 117
Silene alpestris, 152, 154, S. aculis, 154, s. schafta, 155, S. sp., 151
Smith, Dr. A. C., 145
Smith, Kenneth, Report for 1959, 51
Smith, Robert Brookings, 71
Steinberg, Frank, Report for 1959, 59
Steinkuhle, Mrs. Fred, 12
Stellaria media, 118
Stephanotis, 70
Summer Nature Programs, 159

Talinum paniculatum, 157, T. patens, 155, T. teretifolium, 155
Taraxicum officinale, 118
Taxodium distichum, 135
Thunbergia alata, 68, T. gibsonii, 68, T. grandiflora, 68
Tillandsia usenoides, 82
Townsendia hookeri, 155, T. sericea, 155
Trifolium repens, 118
Trumpet Creeper, 141

Utricularia, 4

Van Ravensway, Charles, 37
Van Schaack, Report for 1959, 13, 41, "The Grasses", 104-107
Veronica holophylla, 155, V. repens, 155, V. sp., 151
von Schrenk, Trifon, "The Botanist's Contribution to Timber Conservation", 98-104

Wasinger, Jack, 41
Water Lilies, George Wm. Pring, 93-98
Waterman, Dr. Alan T., 107
Went, Dr. F. W., "Plants of Prey", 1-5, "The Response of Plants to Pruning" 17-19, Report for 1959, 33-40, Cover No. 4, "Epiphytes" 77-83, "How Nature Prepares for Winter", 147-149, and 142, 144, 145
Wheeler, Dr. Marshall R., 145
Whitaker, Dr. Thomas W. "Archeological Cucurbits", 13, 40
Women's Association, 142
Wood, Mrs. Neil, 12, 37
Woodson, Dr. Robert E. Jr., Report for 1959, 41, 145
Wuertenbaecher, Harry W., 143

Zoysia, 109, 111, 122, 123

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SOME FACTS ABOUT SHAW'S GARDEN

The Missouri Botanical (Shaw's) Garden was established in 1859 by Henry Shaw, a St. Louis businessman, to be controlled by a Board of Trustees for the public benefit. The Garden is a non-profit institution which receives no support from the city or state, depending on the income from the Shaw estate supplemented by contributions from the public.

The old stone walls and cast-iron fences, the Linnean House, the Museum Building, the part of the Administration Building which was Shaw's Town House, relocated in the Garden in 1890, and the Tower Grove House, his country home, all date from Mr. Shaw's time. The Main Gate, display and growing greenhouses and most other facilities date from the period immediately following the turn of the century. The Climatron, opened in 1960, is the first of several new buildings planned for the Garden's redevelopment. It is the world's first geodesic dome, fully climate-controlled greenhouse and contains the Garden's tropical collections.

The Garden — 70 acres — is open every day of the year (except Christmas and New Year) from 9 A.M. until sundown, and the greenhouses close at 5 P.M. Tower Grove House is open daily from 10 A.M. to 4 P.M. (December to March on weekends only). The Display House presents four seasonal displays:— November, Chrysanthemums; December, Poinsettias; February, Orchids; Spring, Lilies and other flowers. During the year are other shows, competitions and festivals sponsored by various Garden Clubs and Flower Societies.

Courses in Botany and Horticulture for adults are conducted by the Garden staff. Children's nature studies are provided each Saturday of the year and a special nature program is held during the summer. Information on these activities is published in the BULLETIN or may be had by mail or phone. The Garden maintains a research program through the Henry Shaw School of Botany, Washington University.

In 1926 an Arboretum — 1600 acres — was established at Gray Summit, Missouri. Foot trails and roads pass through the Arboretum and are open to visitors in April and May.

The Garden Administration Building is located at 2315 Tower Grove Ave., and the Garden main entrance is at Tower Grove and Flora Place. The entrance at Tower Grove and Cleveland Avenue is also open to the public. The Garden is served by both the Sarah (No. 42) and the Park-Southampton (No. 80) city bus lines.

Persons interested in helping to support the Garden and taking part in Garden activities are urged to do so through the "Friends of the Garden". Information may be obtained from the Main Gate or by mail or phone.

8